THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXVII. No. 1727.] LONDON, JUNE 16, 1896. [48TH YEAR. PRICE 6d.

THE SILICA FIRE-BRICK COMPANY,

OUGHTIBRIDGE, near SHEFFIELD,

MANUFACTURE

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY

FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY,

Strongly recommended where EXCESSIVE HEATS have to be maintained.

Lanemark Coal Co., LIMITED.

LANEMARK CANNEL AND GAS COALS.

Quotations and Analysis on Application to

LANEMARK COLLIERY, NEW CUMNOCK, N.B.

Shipping Ports: All the principal Scotch Ports.

— ESTABLISHED 1830. —

PARKER & LESTER,

Manufacturers & Contractors.

THE ONLY MAKERS OF

PATENT ANTIMONY PAINT, Parker's Imperial Black Varnish,

Oxide Paints, Oils, and General Stores for Gas and Water Works.

WORKS:

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LOG MOUNTAIN COAL, COKE, AND TIMBER CO.
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Cable Address: "Hull, Pineville."

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CARLESS, CAPEL & LEONARD,

HOPE CHEMICAL WORKS, HACKNEY WICK, LONDON, N.E.,

And at Pharos Works, Hackney Wick.

NAPHTHA AND GASOLINE DISTILLERS AND PETROLEUM IMPORTERS,

Specially distil Carburine Spirit, specific gravity ·680, or of any other grade suitable for Enriching Gas; also Gas Oil best adapted for injecting into the Retorts, as in the Herring Process.

Importers of Petroleum for Carburetting Water Gas, or for Manufacturing Oil Gas. Distillers of Pentane, Petroleum Ether, and Naphtha for clearing the pipes of Naphthaline, &c.

Samples and Prices may be had on application.

MELDRUM'S Patent

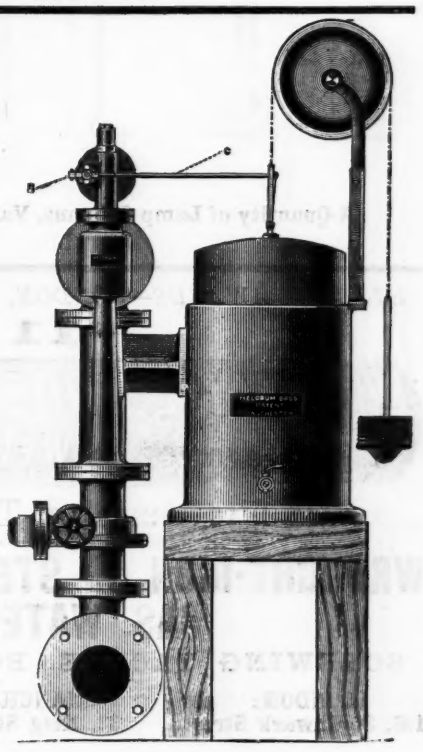
Gas EXHAUSTER & GOVERNOR.

ABSOLUTELY AUTOMATIC.

REQUIRES NO ATTENTION WHATEVER.

Guaranteed perfectly steady Gauge, no matter how Steam Pressure may vary.

— HIGHEST REFERENCES GIVEN. —



MELDRUM BROS., Atlantic Works, City Road, MANCHESTER.

Telegrams: "MELDRUM, MANCHESTER." National Telephone: No. 1674.

DANIEL HOWARD,

(Successor to the late BENJ. WHITEHOUSE),

GASHOLDER & BOILER WORKS,

WEST BROMWICH, NEAR BIRMINGHAM

(ESTABLISHED 1765),

MANUFACTURER OF TELESCOPIC AND SINGLE GASHOLDERS,

WROUGHT AND CAST IRON TANKS FOR DITTO,

PURIFIERS, CONDENSERS, SCRUBBERS, HYDRAULIC MAINS, and all kinds of GAS APPARATUS,

Wrought-Iron Roofs, Bridges, Girders, &c.,

Steam, Hot Water, and Range Boilers, Tanks, Cisterns, Boats, and all kinds of Wrought-Iron Work.

DRAWINGS, SPECIFICATIONS, AND ESTIMATES SUPPLIED ON APPLICATION.

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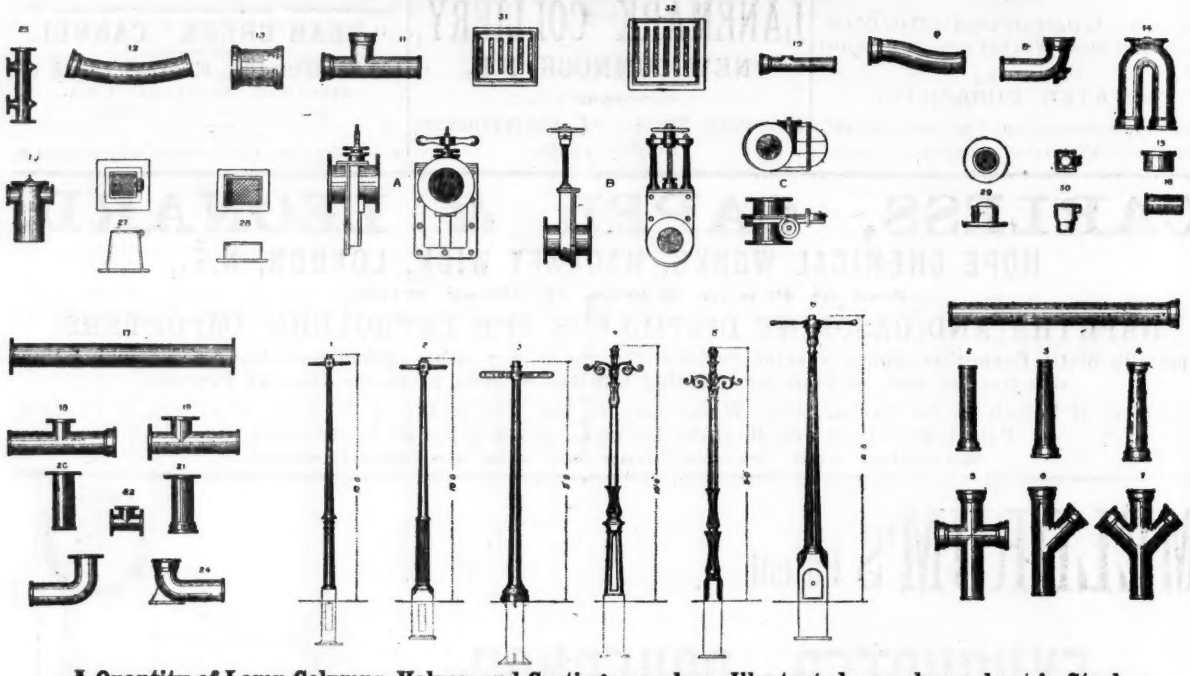
GAS ENGINEERS, CONTRACTORS, IRON & BRASS FOUNDERS, &c.,

FROME, SOMERSET.



A Quantity of Lamp Columns, Valves, and Castings, as above Illustrated, are always kept in Stock ready for immediate delivery.

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WROUGHT-IRON OR STEEL MAINS UP TO 6 FEET DIAMETER, FOR GAS, WATER, OIL, OR OTHER PURPOSES.

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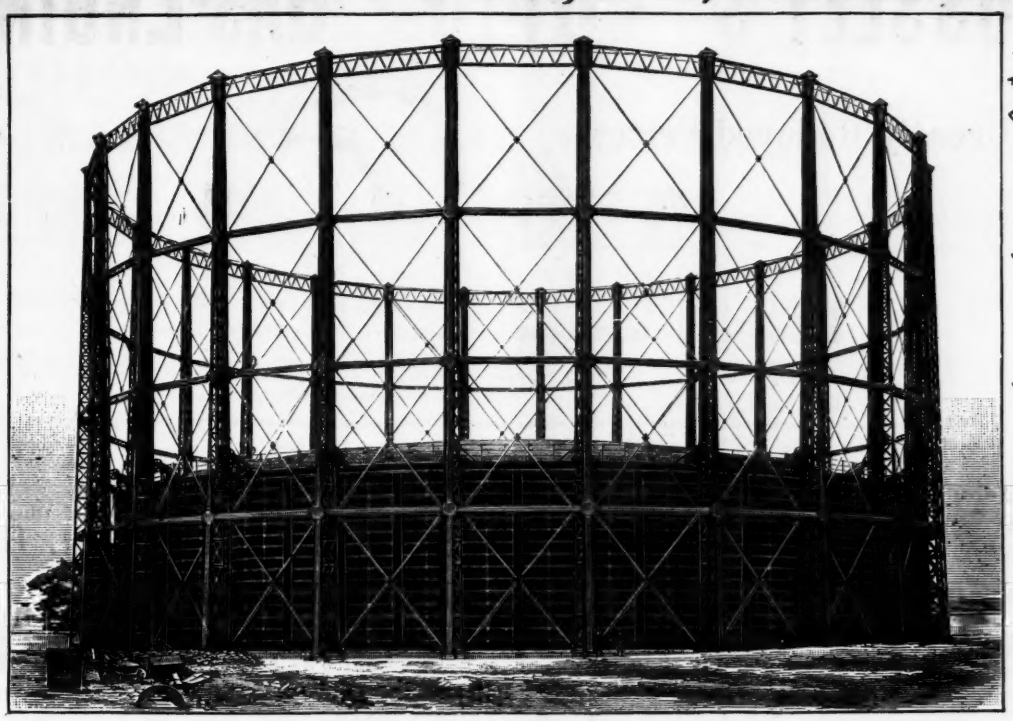
LONDON OFFICE: ST. THOMAS APOSTLE, E.C.

GAS PLANTS, BOILERS, ENGINES, PUMPS, ROOFS, RETORT-FITTINGS, ETC.



TELEGRAPHIC ADDRESS: ATLAS BIRMINGHAM

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MANUFACTURERS SOLELY OF

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INSTALLATIONS have already been supplied, and are in operation at the following Gas-Works: COPENHAGEN, BELFAST, GLASGOW, BRUSSELS, SANTIAGO, SWANSEA, TOTTENHAM, LIVERPOOL, BRIGHTON, BATH, PRESTON, SOUTHPORT, NEW YORK, NEWBURGH (N.Y.); and are in course of erection at: BELFAST (Second Contract), EDINBURGH, TOTTENHAM, WINCHESTER, HOYLAKE, MANCHESTER, BRUSSELS (Second Contract), ST. JOSEPH (MO.), HOLYOKE (MASS.), SHANGHAI.

All Particulars from Patentees: 9, VICTORIA STREET, LONDON, S.W.

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REAL OLD SILKSTONE GAS COAL,

Address THE STRAFFORD COLLIERIES COMPANY,

Near BARNSLEY, SOUTH YORKSHIRE.

NEWTON, CHAMBERS, & CO., LIMITED,

THORNCLIFFE IRON-WORKS, near SHEFFIELD,

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OR
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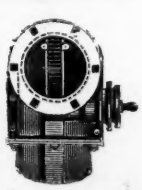
AND
Gasholder Tanks.



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RETORT-BED FITTINGS,
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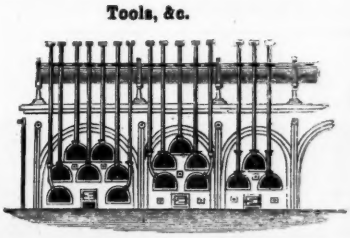
of every description,
Iron Roofs, Columns, Girders, Floor Plates, Tools, &c.



WROUGHT AND CAST IRON
CONDENSERS, SCRUBBERS, & WASHERS,
TAR AND LIQUOR PUMPS, &c.

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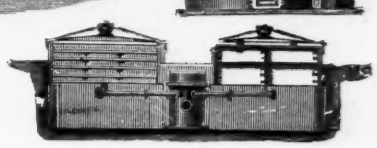
CENTRE-VALVES
for working Purifiers,
Also Bye-Pass & Stop Valves.

PURIFIERS with Planed Joints,
HAND and HYDRAULIC LIFTING GEAR, CAST-IRON MAINS, and SPECIALS.
WOOD GRIDS.
CAST AND WROUGHT IRON TANKS AND CISTERNS.



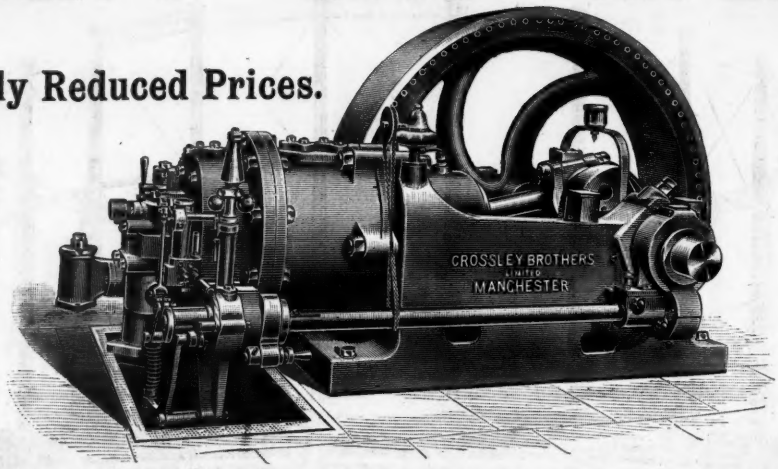
DESIGNS, SPECIFICATIONS, AND ESTIMATES FREE.

Pig Iron (*Special Quality*) for ENGINE CYLINDERS, &c.

GAS COAL FAMOUS FOR ITS UNRIVALLED EXCELLENCE.

CROSSLEY'S "OTTO" GAS-ENGINES

Greatly Reduced Prices.



REPRESENTS NEW TYPE 40-HORSE POWER NOMINAL HIGH-SPEED ELECTRIC-LIGHT ENGINE.

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HARRIS & PEARSON,

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MANUFACTURERS OF

FIRE-CLAY GAS-RETORTS, FIRE-BRICKS, LUMPS, & TILES of Every Description.

GLAZED BRICKS AND PORCELAIN BATHS.

THE GAS-METER COMPANY, LIMITED,

MANUFACTURERS OF

WET AND DRY GAS-METERS, STATION METERS, GOVERNORS, GAS APPARATUS, ETC.

SQUARE STATION METERS WITH PLANED JOINTS.

STATION METERS IN CYLINDRICAL CASES.

DESIGN No. 2 PATTERN.

STATION METERS MADE AT THE COMPANY'S WORKS, OLDHAM, LATE WEST & GREGSON. Established 1830.

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Telegraphic Address: "METER."

[See Advertisement on back of Wrapper.

JOHN BROWN & CO., LTD., SHEFFIELD.

Proprietors of

ALDWARKE MAIN, CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 Feet of 19-Candle Gas per Ton.

Value in Pounds of Sperm, 820·80.

VERY FREE FROM IMPURITIES.

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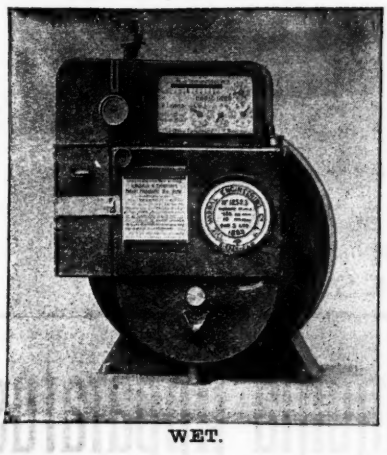
THE LIVERPOOL METER COMPANY, LTD.

Patent New Prepayment Meters.



WET.

THE "PERFECT" AUTOMATIC.

Simple! Positive!! Accurate!!!

The only Prepayment Meter with no Springs, Counter-Balance Weights, or Frictional Gearing to get out of order.

DRY.

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CLAPHAM BROTHERS, LTD.,

— ESTABLISHED 1837 —

Wellington, Nelson, and Market Street Works,

KEIGHLEY, Yorks.

RETORT-FITTINGS,
CONDENSERS,
PURIFIERS, WITH PLANED JOINTS.

GASHOLDER TANKS,
COLUMNS, GIRDERS,
LAMP-POSTS,

And all Kinds of Gas-Making Apparatus and General Ironwork.

GAS and WATER VALVES and MAINS.

ILLUSTRATED CATALOGUES ON APPLICATION.

ALSO SOLE MAKERS OF

Laycock & Claphams' Patent "ECLIPSE" WASHER-SCRUBBER,

Which is efficiently dealing with a total of **85,600,000** Cubic Feet of Gas per day.

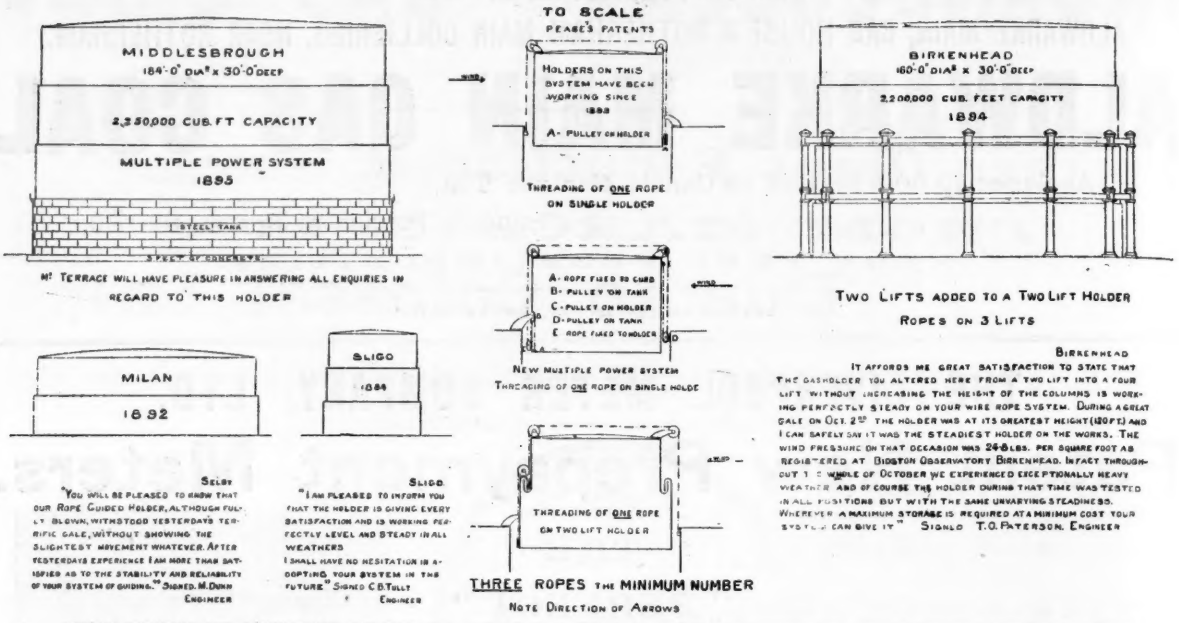
Repeat Orders speak for themselves, some of which are given below—

			CAPACITY, CUB. FT.
Sheffield United Gas Company	2	Machines	1,500,000 each.
Do. do.	2	,,	4,000,000 ,,
Halifax Corporation . . .	2	,,	3,000,000 ,,
Keighley Corporation . .	2	,,	1,000,000 ,,

			CAPACITY, CUB. FT.
Manchester Corporation. .	2	Machines	4,000,000 each.
Do. do. . .	1	Machine	3,000,000
Rochester, Chatham, & Strood . . .			1,000,000
Do. do. . . .			1,500,000

CONTRACTORS TO HER MAJESTY'S GOVERNMENT.

DIAGRAMS ILLUSTRATING REPRESENTATIVE ROPE GASHOLDERS



Mr TERRACE WILL HAVE PLEASURE IN ANSWERING ALL ENQUIRIES IN REGARD TO THIS HOLDER

SELBY

"YOU WILL BE PLEASED TO KNOW THAT OUR ROPE GUIDED HOLDER, ALTHOUGH FULLY BLOWN, WITHSTOOD YESTERDAYS TERRIFIC GALE, WITHOUT SHOWING THE SLIGHTEST MOVEMENT WHATEVER. AFTER YESTERDAYS EXPERIENCE I AM MORE THAN SATISFIED AS TO THE STABILITY AND RELIABILITY OF YOUR SYSTEM OF GUIDING." SIGNED. M. DUNN ENGINEER

SLIGO

"I AM PLEASED TO INFORM YOU THAT THE HOLDER IS GIVING EVERY SATISFACTION AND IS WORKING PERFECTLY LEVEL AND STEADY IN ALL WEATHERS I SHALL HAVE NO HESITATION IN ADOPTING YOUR SYSTEM IN THE FUTURE." SIGNED C.B. TULLY ENGINEER

BIRKENHEAD

IT AFFORDS ME GREAT SATISFACTION TO STATE THAT THE GASHOLDER YOU ALTERED HERE FROM A TWO LIFT INTO A FOUR LIFT WITHOUT INCREASING THE HEIGHT OF THE COLUMNS IS WORKING PERFECTLY STEADY ON YOUR WIRE ROPE SYSTEM. DURING A GREAT GALE ON OCT. 2ND THE HOLDER WAS AT ITS GREATEST HEIGHT (120 FT.) AND I CAN SAFELY SAY IT WAS THE STEADIEST HOLDER ON THE WORKS. THE WIND PRESSURE ON THAT OCCASION WAS 24·8 LBS. PER SQUARE FOOT AS REGISTERED AT BIDSTON OBSERVATORY BIRKENHEAD. IN FACT THROUGHOUT THE WHOLE OF OCTOBER WE EXPERIENCED EXCEPTIONALLY HEAVY WEATHER AND OF COURSE THE HOLDER DURING THAT TIME WAS TESTED IN ALL POSITIONS BUT WITH THE SAME UNVARYING STEADINESS. WHEREVER A MAXIMUM STORAGE IS REQUIRED AT A MINIMUM COST YOUR SYSTEM CAN GIVE IT." SIGNED T.O. PATERSON, ENGINEER

THESE HOLDERS ARE CONSPICUOUS FOR STEADY AND LEVEL WORKING UNDER ALL CONDITIONS, THEY WORK WITH MUCH LESS FRICTION AND IRREGULARITY IN A GALE OF WIND THAN GASHOLDERS WITH COLUMNS, AND ARE ALWAYS STEADY.

ASHMORE BENSON PEASE & Cº Lº.

GAS WORKS CONTRACTORS

STOCKTON-ON-TEES

LATEST

Improvements in Sulphate of Ammonia Apparatus

(COLSON'S PATENT)

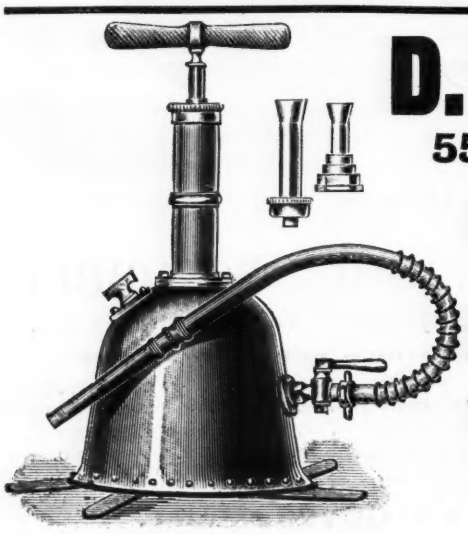
EXTRACT FROM ENGINEER'S REPORT—

"I can now obtain **60** Tons of Sulphate of Ammonia per week with 'Colson's' Still, using **ONE** Boiler, whereas, with my former continuous plant, **TWO** Boilers were required to produce **40** Tons per week."

For Prices and Particulars, apply to the Sole Makers—

ASHMORE, BENSON, PEASE, & CO., LIMITED,

Gas-Works Contractors, STOCKTON-ON-TEES.



D. HULETT & CO., LTD.

55 & 56, High Holborn, London.

GAS SERVICE CLEANSERS.

LAMP TORCHES.

DRY GAS-METER MAKERS.

WROUGHT-IRON TUBES & FITTINGS.

STREET LAMPS & POSTS.

PRICE LISTS ON APPLICATION.

INCANDESCENT GAS-LIGHT

(Welsbach Patents).

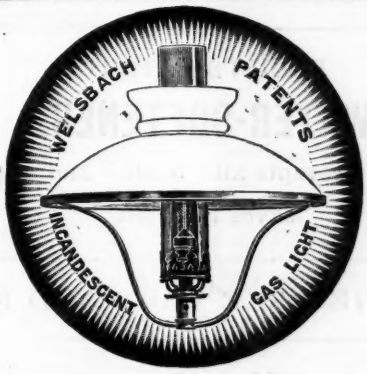
Further Great Reduction in Prices,

FROM MARCH 2, 1896,

Due to Colossal Sales,

Places this highly popular Light within the means of all classes.

The greatly Reduced Consumption of Gas COVERS THE INITIAL COST OF THE BURNERS IN FROM SIX TO EIGHT MONTHS.



The PRICES have been REDUCED as follows:—

The Ordinary "C" Burner to 6s. 6d.

The "C" Bye-Pass Burner to 7s. 6d.

Prices of other Patterns reduced proportionately.

SPECIAL ATTENTION IS CALLED TO THE

"S" BYE-PASS BURNER, PRICE 7s. 6d.

Which, with a Consumption of 2¼ Cubic Feet of Gas an hour, gives a light of 25 to 30 Candle Power.

This Pattern is particularly recommended where it is desired to effect a large saving in Gas rather than to effect a great increase in the Light.

The attention of Gas Managers and Gas Engineers is called to this System of Lighting as one which tends to Popularize the use of Gas as an Illuminant, owing to the following Advantages—

ECONOMY IN CONSUMPTION OF GAS, COMBINED WITH HIGH ILLUMINATING EFFICIENCY.

FREEDOM FROM SMOKE, DIRT, AND FLICKERING.

GREATLY REDUCED HEAT.

The *Lancet* Special Analytical and Sanitary Commission, in an exhaustive report, pronounces the Incandescent Gas-Light System to be the Healthiest, Best, and most Economical System of Gas Lighting.

SUITABLE FOR EVERY PURPOSE OF INSIDE OR OUTSIDE LIGHTING.

For further Particulars, apply to

The INCANDESCENT GAS-LIGHT CO., LIMITED,

Palmer Street, Westminster, London, S.W.

KIRKHAM, HULETT, & CHANDLER, LD.

3 & 4, Palace Chambers, Bridge Street, Westminster, S.W.

PATENT

"STANDARD" WASHER-SCRUBBERS

☛ **505** in use, and several in course of construction. Maximum Washing Surface. Minimum Back-Pressure and Power required to drive. Efficiency Guaranteed.

MARSHALL'S PATENT
TAR-EXTRACTOR.
Extracts all the Tar without choking up.

BRUUN'S PATENT
WATER-SOFTENER.
Prevents all "Scale," and saves Fuel, &c.

BURMEISTER & WAIN'S
TAR-SEPARATOR.
Extracts over 99 p.c. of Ammoniacal Liquor from Tar.

FOR OTHER SPECIALITIES, SEE LAST AND NEXT WEEK'S ISSUE.

Prices, &c., on application to above address.

THE

MAXIM PATENT CARBURETTOR

FOR ENRICHING GAS IN BULK.

Over 50 Maxim Patent Carburettors have now been fixed, capable of enriching

650,000,000

CUBIC FEET OF GAS PER DAY.

Among the Companies supplied are The Gaslight and Coke Company, the South Metropolitan Gas Company, Birmingham Corporation, Manchester Corporation, Rochdale Corporation, Bristol Gas Company, and many other Works, both large and small, where they have been working in some instances for the past **FOUR YEARS.**

More Gas and saleable Coke per ton of Coal Carbonized is produced; saving Capital, Labour, Fuel, Wear and Tear, &c.

The Enrichment is **INSTANTANEOUS** and **PERMANENT.**

The Carburettor is inexpensive, easily fixed, and entirely supersedes the use of Cannel.

SOLE AGENTS FOR REDWOOD & CLOWES' INFLAMMABLE VAPOUR & GAS DETECTORS.

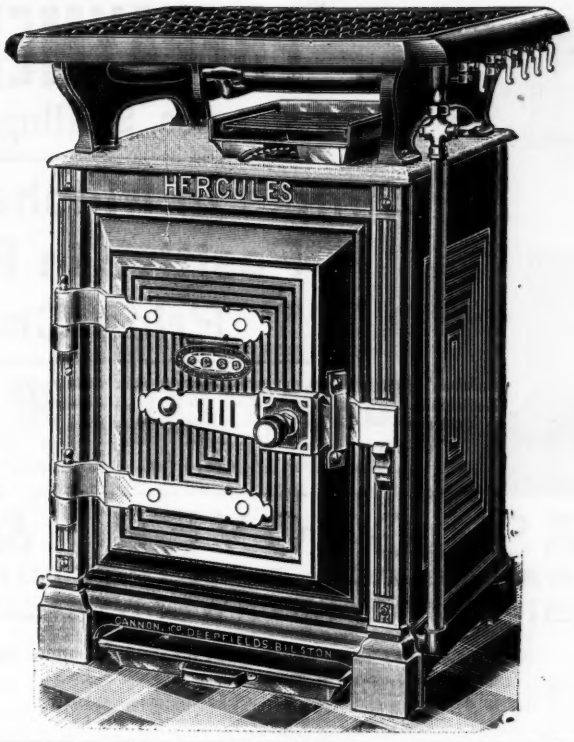
Dealers in Carburine and all other Naphthas for the Enrichment of Gas.

FOR PRICES AND FULL PARTICULARS, APPLY TO

THE GAS LIGHTING IMPROVEMENT COMPANY, LIMITED,

18, DEVONSHIRE STREET, BISHOPSGATE, LONDON, E.C.

CANNON GOLD-MEDAL
"HERCULES" GAS-COOKER.



IMPORTANT TO GAS COMPANIES.

This Gas-Cooker has met the demand of Gas Companies for a Cast-Iron Gas-Cooker with an interior of **PURE PORCELAIN ENAMEL.** For many years we have supplied the leading Gas-Stove Makers with Enamelled Castings for Gas-Cookers. This Cast-Iron Enamel is the result of a special process known as "Porceliron." It has the following special

ADVANTAGES.

1. **Superiority over Enamelling on Sheet Iron; Strength and Durability being obtained.**
2. **Will not chip or wear away.**
3. **Not affected by action of Grease, &c.**
4. **Absence of Pin Holes; and therefore Rust Proof.**

By using the "Hercules" Gas-Cooker, you have a Stove which will last at least 25 per cent. longer than any other Cooker in the Market. We have met with perfect success; and for the purpose of directly bringing this Cooker before Gas Engineers, we are willing to send any size Cooker for inspection.

No.	Inside Dimensions of Oven.			Hot-Plate.	Height over all.	Burners on Hot-Plate.	Average Cost three meals per day. Gas 3s. 6d. per 1000 c. f.	List Price with interior Enamelled complete, and Enamelled Crown Plate.
	High.	Wide.	Deep.					
2013	26-inch	12-inch	10-inch	21 by 17½-inch	36-inch	2	2d.	**£4 12 6** each.
2014	26 ,,	14 ,,	12 ,,	23 ,, 19½ ,,	36 ,,	3	2d.	**5 15 0** ,,
2015	26 ,,	16 ,,	14 ,,	25 ,, 21½ ,,	36 ,,	4	2½d.	**6 10 0** ,,
2016	26 ,,	18 ,,	16 ,,	27 ,, 23½ ,,	36 ,,	5	3d.	**7 13 6** ,,
2017	26 ,,	20 ,,	18 ,,	29 ,, 25½ ,,	36 ,,	6	3d.	**9 4 0** ,,
2018	26 ,,	22 ,,	20 ,,	31 ,, 27½ ,,	36 ,,	7	4½d.	**12 10 0** ,,
2019	26 ,,	24 ,,	22 ,,	33 ,, 30½ ,,	36 ,,	8	6d.	**13 5 0** ,,

NOTE.—No extra charge for Enamelled Crown Plate. The Shelf Rests are Enamelled without extra charge.

THE CANNON HOLLOW-WARE CO., Ltd.,

DEEPFIELDS, Near BILSTON, STAFFS.

London Show-Rooms: 58, HOLBORN VIADUCT, E.C.

Established 1826. Send for Complete List (Post Free).

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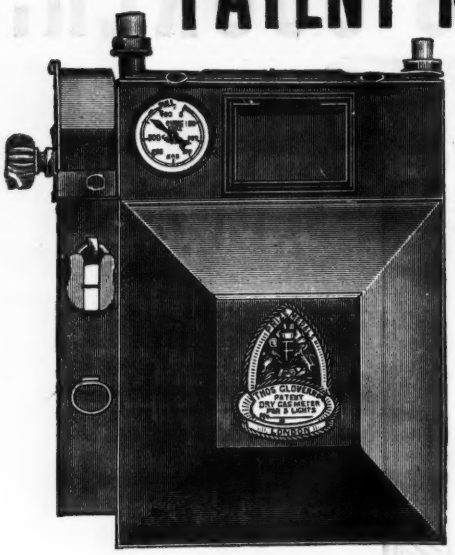

PREPAYMENT METER

For Pennies, Shillings, or any Coin.

Simple in Mechanism.
Positive in Results.
Price Changer *in Situ.*

GUARANTEED FOR FIVE YEARS.

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THOMAS GLOVER & CO.,

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62, VICTORIA STREET.	3, BRIDGE ROW, DERITEND.	37, BLACKFRIARS STREET.
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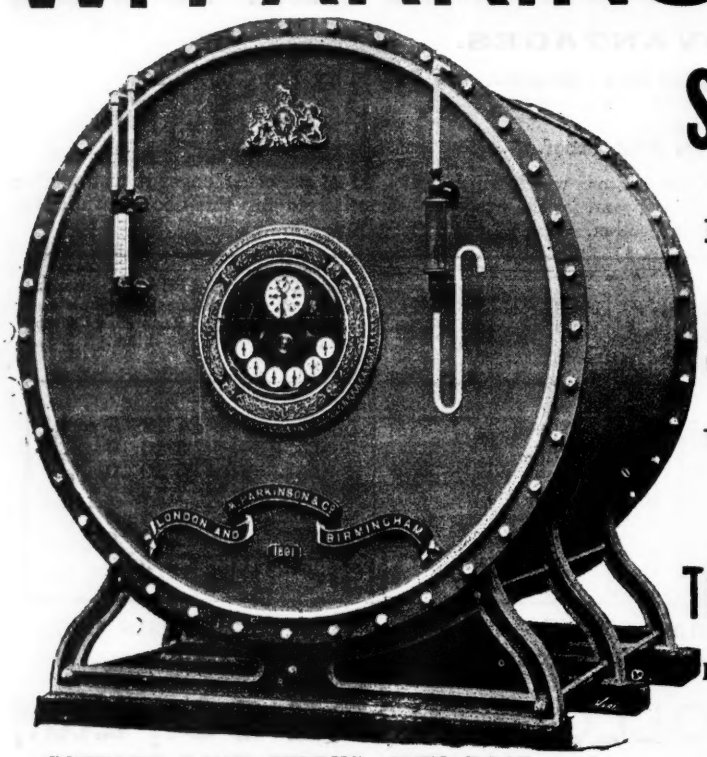
W. PARKINSON & Co



STATION METERS

IN

ROUND or SQUARE TANKS.

500 STATION METERS,

Varying in size from **1200** to **250,000** cubic feet per hour, have been sold fitted with

THREE-PARTITION DRUMS.

DURABILITY UNEQUALLED. SOME HAVE BEEN IN CONSTANT USE FOR OVER 60 YEARS.

COTTAGE LANE WORKS, CITY ROAD,	BELL BARN ROAD WORKS,
LONDON.	**BIRMINGHAM.**
Telegraphic Address: "INDEX."	Telegraphic Address: "GAS-METERS."

[See also Advt. p. 1368.

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EDITORIAL NOTES.

The Gas Institute Meeting.

THE meeting of the Incorporated Gas Institute last week was thoroughly successful and satisfactory in every respect, amply confirming the congratulatory terms in which the Council reported upon the actual condition of the Institute for the time being. Not only have the membership of the Institute kept up and the finances once more attained equilibrium, but it was impossible to follow the proceedings of the meeting without noticing, as their most salient feature, that the organization has renewed itself in spirit. During the past few years, there has been evident in the arrangements and conduct of the meetings a certain straining to obtain an appearance of success; and there has accordingly been a degree of self-consciousness in the devotion to duty of those who were responsible for rehabilitating the reputation of the Institute, which created an impression that without persistent and extraordinary effort on the part of a few prominent members, the future of the organization could hardly be assured. Doubtless the last five or six years have been an anxious era in the history of the Institute, which owes everything to the devoted efforts in question. The time has now come, however, when it can be safely said that the Institute as a whole has recovered a tone of self-reliance which absolves those called to office under its constitution from any extraordinary anxiety on its behalf. This is at any rate the impression that immediately suggests itself upon reflection over last week's doings. The attendance at the meetings, which lasted three whole days, was good; and the members generally applied themselves with a single mind to the business in hand. There was a notable absence of much that has on previous occasions tended to bring these gatherings into discredit; and if the assembly was still rather less homogeneous than could be wished, evidence was not lacking that the present Council are resolved upon a policy of good-humoured but strong repression and discouragement of the less desirable element which the organization has inherited from its ill-regulated past. We are careful to make this clear, because it would be idle to attempt to ignore the fact that some who will read these lines are no friends of the Institute, and would not be sorry to believe that it has entered upon a period of decrepitude pointing to eventual dissolution. On the other hand, there are those who look for the same fate to overtake the younger and smaller organization which essays to represent a distinct order among the followers of the British gas industry. We are loth to offer any remarks that may appear, or be misconstrued into appearing, to support either party. Time was—we cannot and do not seek to deny the record—when it has appeared to us that the less worthy elements of the older and more loosely organized technical society exerted so overpowering an influence over its character, and were so indissolubly bound up with its corporate existence, as to favour the opinion that disintegration was the only possible preliminary to purification and cure. Things have taken another course; and it is for wise men to make the best of circumstances which cannot be controlled. To say that the Institute has completely revolutionized itself would be a wrong description of its present state; but that there has been a great and beneficent improvement in its condition and prospects cannot be denied. It is still unwieldy, of course; it is far too large, and contains elements unsuitable for the proper accomplishment of what the best of its members regard rightly as its most desirable objects. The principal factor in the proximate development of the Institute, however, is the fact that it is again the best type of members who have succeeded to the ruling positions, and are trying to mould the organization in accordance with their own ideas—with regard, naturally, to the circumstance of their having an old and not a new society to deal with.

The great facility which the new Council enjoy in order to the fulfilment of their praiseworthy efforts to make the Institute better than it ever was as an agency for the cultivation of sound technics and the spread of good-fellowship among British gas managers, is the steady and large influx of fresh blood into the organization, and the gradual, but sure, elimination of what was undesirable in the old membership. Time flies, and it is no longer the same Institute that passed through such injurious

experiences during the middle "eighties." The meetings are full of fresh faces, mostly of men who come early and stay on to do business. The list of papers this year indicates this change; and the reported discussions will still further illustrate it. Next year, the attraction of novelty is likely to be still more pronounced. One can hardly make observations of this kind with sufficient point without mentioning names; but anyone who assiduously attended the meetings in the Adelphi last week, with experience of the old days, would have missed many whilom satellites of the Institute whose absence was distinctly grateful.

This process will go on and gather strength with years. If the Council and the principal officers of the Institute remain staunch in their present policy of discouraging the admission of candidates for membership whose credentials are, to say the least, questionable, the Institute will purge itself of whatever may detract from its dignity and usefulness. That this movement has already progressed far, was shown by the vastly increased seemliness of last week's meetings, including the excursion. If a firm control is maintained upon all future arrangements for the relaxation as well as for the technical regalement of members attending the Institute meetings, the old "beanfeast" tradition will be effectually stamped out. There is no need for any affectation of exclusiveness in regard to these arrangements. The Institute has always admitted and welcomed "friends" to its outings; and one would be loth to see any difference made in this regard. If a stop is put, once for all, to the objectionable practice of "sending round the "hat" by local "Entertainment Committees"—an evil which only arises in connection with provincial meetings—so that the excursions and amusements are made self-supporting, there will no longer be the same attraction to outsiders to force themselves into temporary connection with the Institute, and a nuisance of long standing will be abrogated.

Obviously, the improved spirit of the Institute meetings—never so strongly manifested as this year—is very greatly due to the elimination, by efflux of time, of the partisan feeling which went so far to originate, and was itself so unnaturally forced into luxuriance by, the constitutional troubles that are now ancient history. It is to nobody's interest now to garble and misrepresent facts and remarks, and so embitter controversy that those who merely disagreed upon certain points were forced into becoming irreconcilable opponents. It is premature as yet to talk of uniting those who were driven apart by these mischievous influences; but at least it is possible to prepare for the future without thinking too much about the irrevocable past. Parties may be founded by opposing personalities; but they must grow by recruiting in the present and the future. If, of our two national societies representing the gas industry, one has shown an example to the other, the degree in which it is copied marks the only formal difference between them; and as uniformity is approached, so the difficulty of showing preference for one or the other will increase for the neophyte. It is the comparative rate of natural growth which will eventually determine the fate of these organizations. Older men will continue to support one or the other, or both, as the strength of their associations predisposes their inclinations or inspires them with catholicity of sentiment; but the younger aspirants for the benefits of association with their fellows will certainly elect to go with the majority.

The Gas Clauses of the Dublin Corporation Bill Thrown Out.

Once more the Dublin Corporation have been shamefully overthrown in conflict with the Alliance Gas Company. The amazing Bill of the Corporation, the character of which as regards the gas clauses will be known to our readers from our previous notices, had occupied the time of a House of Lords Committee for several days before this particular section of it was disclosed before their Lordships' astonished gaze. It did not long occupy their attention; for as soon as the petitioners' case was presented, it was dismissed, without any call upon the Company's advocates or witnesses. The Company might possibly have had their costs upon application; but it really does not matter out of what pocket the unfortunate Dublin resident takes them—either as gas consumer or as ratepayer—he pays for all these performances of his egregious Local Authority. It is entirely his own fault. So long as the ratepayers of Dublin consent to the persistent mismanagement of their local affairs by an organized set of Corporation fee-mongers and officials paid to keep up a *régime* of litigation and Bill promoting, so long will these scandals continue. In connection with this particular Bill, the Corporation have sought far and near for witnesses of credit and standing to bolster up their case; and the team they actually put forward represent merely the residuum found in the bottom of a widely-cast net. The contemptuous way in which the Committee put a stop to the case, is no compliment to anybody concerned in framing or supporting it. Gas supply by companies would be impossible if such a cause as that laid before Parliament by the Dublin Corporation were sustainable. It had to be met, of course, upon its merits, such as they were, which meant the preparation for the Company of a good deal of highly interesting evidence that will not now see the light. The Company would have been defended by as strong a set of witnesses as was ever got together for such a purpose; and it is almost to be regretted that their services will not be required. Their evidence could not have failed to be of the highest interest. The object of opposing a Bill, however, is to cause its rejection; and it is of the utmost importance to the Dublin Company that the latest attack upon their position has failed—not through the strength of the defence, but by the weakness of the assault.

The Incandescent Gas-Burner Litigation.

A further stage has been reached in the course of the incandescent gas-burner litigation, as will be seen by our "Legal Intelligence" to-day, in the withdrawal, by leave, of the appeal of the Incandescent Gas-Light Company against the judgment given in favour of the Sunlight Company. We must refer to our previous reports, and our editorial comments upon this judgment, which appeared in the "Journal" for April 21, in order that the exact meaning of this latest step in the litigation may be understood. We were rather surprised at the time that the Incandescent Gas-Light Company should have appealed against the judgment in the Sunlight Company's case, seeing the character of the victory gained by the latter Company. Litigants, however, are in the hands of their legal advisers; and the natural presumption would be in favour of following the advice that had carried the plaintiffs so far. Now different counsels have prevailed; and the appeal is abandoned. It does not follow from this that all litigation between the Incandescent and Sunlight Companies is at an end. We understand that other steps have actually been taken, in regard to both the Dellwik and Haitinger patents, which may have the effect of putting a very different complexion upon the position in law of those who claim to be entitled to work under these patents. It was, indeed, hardly reasonable to suppose that matters in this respect would be permitted to rest as Mr. Justice Wills left them. It would therefore be rash to assume that the contest for supremacy between the Welsbach mantles and those of the "cheaper edition" will just yet decline into the commercial phase. The lawyers have got a firm grip of both kinds of mantles for the present; and there is small prospect of their letting go yet awhile for the commercial gentlemen to have their turn. In the meantime, the letter of Mr. Julius Moeller, which we publish to-day, on Professor Lewes's paper read at the meeting of the Institution of Gas Engineers, will be perused with interest. We remarked at the time upon the "lurid tinge" imparted to his treatment of the subject by the accomplished lecturer; and it will be curious to observe how the matter of the paper will stand the fierce white light thrown upon it by Mr. Moeller.

The Private Interest of Members of Parliament in Bills.

The Select Committee of the House of Commons appointed "to inquire and report whether it is desirable to define "more precisely the nature and extent of personal "pecuniary interest in any question before the House "which would disable a member of the House from voting "upon such question, and what procedure can most "advantageously be adopted for enforcing such disability," have begun taking evidence. The first day's proceedings are reported at length in "The Times" for the 12th inst., and form very instructive reading for those who are interested in the immediate question and its possible developments. A classified statement of precedents,

rulings, and reports of proceedings bearing upon the subject, as it has occupied the attention of Parliament from time to time, has been prepared by Sir Reginald Palgrave, the Clerk of the House; and the Speaker was examined by the Committee on the state of the question as recorded in this very careful and complete statement. There is no Standing Order of the House of Commons dealing with the matter; nor is there any rule respecting it in the printed Rules and Orders. But there is an unwritten order, deduced from a ruling of Mr. Speaker Abbot; and this has been carried into effect in a number of decisions upon particular instances. According to Mr. Speaker Gully's view, as given to the Committee, the rule is that "a member is "disqualified from voting on any question in which he has "a direct personal pecuniary interest of a private and "particular rather than of a public and general nature." The latter words have been added to the definition, because it has been said on some occasions that the disqualification does not operate in the case of Public Bills, or in the case of Private Bills which involve a great public interest; and the Speaker holds that the declaration that the interest must be of a private and particular, not of a public and general nature, covers the cases both of Public and Private Bills. The application of this principle must be left to be made to paritcular instances as they occur. An important point is that since 1823 the procedure has been that the member has voted, and the question of the allowance of the vote has been subsequently considered—the member being in the meanwhile directed to withdraw. Another important point is that any question about a vote should be raised promptly, so that if the votes are to be disallowed they may never appear on the records. With regard to Private Bills, there has been a tendency of late years to allow the votes of directors which in earlier times would have been disallowed. There has never been a vote on a Private Bill disallowed from 1837 to the present day. In these cases sometimes directors were concerned and sometimes shareholders; one such instance being that of a director of Metropolitan Water Companies in 1884. There has been a difference of procedure in regard to the composition of Committees. Up to 1844, it was rather the rule to choose members of Private Bill Committees because of their local knowledge; but since this period the rule has been to require members of such Committees to state that they have no personal interest in the Bill, and that their constituents have no local interest in it. On the general question, the Speaker's opinion is decidedly against any attempt to define the rule more closely, or to put such definition into a printed rule or Standing Order. He thinks that a definition would give rise to a number of new questions, which would occur more frequently than the present question. Again, no definition would be found satisfactory or conclusive. Pressed to say whether it might not be easier to define an interest that would not disqualify, rather than one which would not so operate, the Speaker observed that he thought it "better not." He also declined to recognize the existence of any logical distinction between directors' and shareholders' votes in these matters. He was further of opinion that it would be very inconvenient to apply the rule relating to membership of Private Bill Committees to the entire House. On the whole, it does not appear that the Speaker's evidence favoured the further pursuit of the inquiry; and it is not surprising that at its conclusion the room was cleared, and the Committee adjourned after a short private consultation.

The Lighting Corporation, Limited.—His Royal Highness the Duke of Saxe-Coburg and Gotha visited the show-rooms of the Lighting Corporation, Limited, Bloomsbury Street, W.C., last Friday afternoon. His Royal Highness expressed his high appreciation of the Corporation's system of lighting and ventilation, referred to in an article in the "JOURNAL" for the 9th inst. (p. 1277), which has already been partially installed at Clarence House.

Received.—"A Text-Book of Gas, Oil, and Air Engines; or Internal Combustion Motors without Boiler." By Bryan Donkin, M.Inst.C.E., M.Inst.Mech.E. With 154 illustrations and selected table of trials. Second edition, revised and largely re-written. (London: Charles Griffin and Co., Limited.) "A Practical Treatise on the Otto Cycle Gas-Engine." By W. Norris, M.Inst.Mech.E. With 207 illustrations. (London: Longmans, Green, and Co.) "Inventions and their Commercial Development." By J. Samson, C.E. (London: Simpkin, Marshall, Hamilton, Kent, and Co., Limited.)

WATER AND SANITARY AFFAIRS.

AFTER all the alarming statements which have been made, declaring that the Metropolitan Water Companies were at the end of their resources, and that the supply was failing, so as to render it absolutely necessary that at least a supplemental supply should be brought from the mountains of Wales, we find that, in the opinion of Mr. Dickinson, the Chairman of the Water Committee of the London County Council, and Mr. A. R. Binnie, the Chief Engineer, the scheme of the Staines reservoirs is altogether premature, and for the present quite superfluous. Mr. Dickinson, in his evidence before the Hybrid Committee on the London Water Bills last week, in special reference to the Staines scheme, signified that the three Companies concerned in that project had made an exaggerated estimate of the maximum requirements of the consumers in the future; and, further, that whatever exceptional demand might happen to be made could be met by allowing the Companies to take more water from the Thames. To "take more water" from the river seems such a simple thing; but Mr. Dickinson failed to say where the water was to be put. Mr. Binnie "disagreed" with everything in the Staines Bill, and denied that there was any necessity "for further stor-"age, or further water." He put in tabulated statements "demonstrating" that, according to their own showing, the three Companies "had ample water to last them for years "to come." At 35 gallons per head per day, the resources of the five Thames Companies, according to Mr. Binnie's calculations, were sufficient to enable them to supply a population of 3,428,200—the number actually supplied at the present time being 2,699,515. The New River Company were included in the former statement as to "ample water" for years to come. This latter calculation makes the list of Metropolitan Water Companies complete, excepting only the East London and Kent Companies. The entire review, therefore, comes to this—that the whole of the area covered by the Companies is perfectly provided for, and will be so for "years to "come."

We agree with Mr. Binnie that there is plenty of water at the disposal of the Companies—that is to say, upon an annual basis. Yet it does not follow that there is plenty at all times. Hence the need of reservoirs, though Mr. Binnie does not see it. Rather curiously, we find him anxious about filter-beds. He complains that there are "no filter-beds in the Bill." Well, if there are to be no reservoirs, there need be no filter-beds. Should any difficulty arise, Mr. Dickinson would allow the Companies to take from the river what they wanted; and Mr. Binnie considers that the requirements of the Companies might be met by the powers of inter-sale, "or by overdraft from the Thames." Mr. Binnie disagrees with the "engineering details" of the Staines Bill. But what shall we say of his own engineering, which allows of unlimited drafts, without any further provision in the shape of reservoirs or even filter-beds. The free and easy system by which Mr. Dickinson and Mr. Binnie propose that the Companies shall play with the water of the Thames is in strange contrast to the complaints made not so long ago by the County Council that some of the Companies were drawing water from the Thames in excess of their rights. We have even a faint recollection that the County Council at one time considered that the Thames Conservancy ought to prosecute the Companies for practically stealing water they had not paid for. But the Council objected very strongly to the agreement by which the Conservators granted an enlarged supply to the Companies, the latter making payment for the same. A discovery has now been made that payments to the Conservators by the Companies are a tax on the consumer. Under certain circumstances, this is true; and the same may be said of payments made to Counsel and to witnesses in defending the rights of the Companies against the attacks of the County Council.

At the half-yearly meeting of the Southwark and Vauxhall Water Company last week, the Chairman (Alderman Sir H. E. Knight), as on a former occasion, had a two-fold tale to tell. It fell to his lot to show how a Company could suffer many drawbacks and misfortunes, and yet be in a condition of prosperity. He told the shareholders how the consequences of the frost still bore heavily upon their finances; but he assigned a limit to the loss, by

estimating that all the expenses due to this cause would be met by the £33,000 they had paid, or would have paid, in the course of the next few months. It was true the shareholders had to content themselves with a 4 per cent. dividend; but still they had "an eminently prosperous concern," and they would soon see brighter days. It certainly helps to prove the vitality of a company, when we find £20,000 sacrificed out of dividends, and £13,000 out of surplus profits, without the undertaking being brought into serious difficulties. The shareholders were also congratulated on the disappearance of the eight Transfer Bills of the County Council; measures which Sir Henry Knight did not hesitate to characterize, not for the first time, as "thoroughly iniquitous." But the Transfer Bills were part of the general policy of worry which the County Council persistently pursued in reference to the Water Companies, involving an expenditure of a quarter of a million of money, for which "there was "nothing whatever to show." It is to be regretted that money should thus be wasted, when it is wanted for useful purposes. For a single reservoir, the Southwark and Vauxhall Company have spent £70,000. Other works are to follow; and as the Company have overspent their capital to the extent of £26,000, the Directors are going to issue £100,000 of the debenture stock authorized by the Act obtained in 1894. The expenditure of this money will not be without visible results, conducive to the benefit of the public; but we are reminded that carrying out such works as these takes time, so that if there is anything likely to be wanted within the next ten years, it is needful to get the consent of Parliament at once.

Mr. Frederick Tendron, in presiding over the half-yearly meeting of the Grand Junction Water Company, made reference to the Transfer Bills, and the cost of opposing them. The frost of last year has also put the Company to a large expense for lowering their mains. This process would seem strictly chargeable to capital account; but only a portion has thus been appropriated. Concerning the Staines Reservoirs Bill, Mr. Tendron remarked that the prospect of having a clause introduced compelling the formation of a sinking fund was "a very serious matter." Struck at on all sides, the Companies have to make their reckoning also with the Thames Conservancy, which seeks to obtain increased contributions. Another exaction is due to the local authorities, who augment the rates and taxes so as to swallow up nearly all the increase in the profits. Almost the whole of the £80,000, which the Directors expect to raise by the formation of fresh capital, will go in the construction of new works, designed to prevent any breakdown for the next five years. But the Grand Junction, and all the other Water Companies, may take courage, so long as the House of Commons remains constituted as it is. The Companies will find scope enough to live and to prosper, though trammelled and taxed in a way which befals no other form of joint-stock enterprise.

PERSONAL.

At a Board meeting yesterday of Frank Wright's Prepayment Gas-Meter Corporation, Limited, Mr. JULIUS MOELLER and Mr. L. DE FONBLANQUE were elected Directors.

The will of Mr. JOHN CLARKSON MAJOR, the well-known chemical manufacturer of Wolverhampton, who died on Dec. 21 last, has just been proved. The personalty is sworn at £56,414 gross and £49,983 net.

The vacancies caused on the directorate of the Wakefield Gas Company by the death of the late Chairman, William Statter, Esq., J.P., have now been filled. His son, Mr. W. AKED STATTER, succeeds him in the chairmanship; and Mr. R. E. GOLDTHORP has been elected to fill the vacancy on the Board.

Mr. CHARLES WOOD, the Assistant Gas Engineer of the Bradford Corporation, has had his salary raised by £75 per annum. When the question was before the Council last Tuesday, the Chairman of the Gas Committee (Mr. W. C. Dixon) explained that the late Manager (Mr. Swallow) received £1000 a year; and he was pensioned off with £500 a year. At present the united salaries of Mr. William Wood and Mr. Charles Wood only amounted to £625; and on the latter gentleman now devolved most of the scientific part of the work. He was probably the worst-paid man in the service of any corporation gas-works of similar size, or of any large gas company. Mr. Dixon added that he had peculiar pleasure in bringing forward the motion, because of the fact that he had taken part not very long ago in controversies with Mr. Charles Wood; and he was desirous of showing that these circumstances had not influenced him in any way.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTY-THIRD ANNUAL GENERAL MEETING,

HELD AT THE

SOCIETY OF ARTS, LONDON, JUNE 9, 10, 11, 1896.

W. R. CHESTER, Esq., M.Inst.C.E., President.

REVIEW OF PROCEEDINGS.

THE Thirty-third Annual General Meeting of the Incorporated Gas Institute opened promisingly last Tuesday, with fine weather and a good attendance; and although the former condition was not maintained throughout, the latter was very fairly in evidence during the whole of the three days' proceedings. Indeed, it may be acknowledged at once that there was no sign of financial, numerical, technical, or other kind of weakness in the organization over which Mr. W. R. Chester has presided, during the official year that has just been brought to so satisfactory a conclusion with a gathering that did not fall short in any respect of the best that the Institute bears upon its records.

The reading of the report of the Council for the past year brought the new Secretary—Mr. Walter T. Dunn—before the meeting; and the impression he made then and afterwards was a very favourable one. After the report came the presentation of premiums to readers of papers at last year's meeting; the President's Medal and the first premium deservedly going to Mr. D. Irving, of Bristol, for his useful monograph on "Unaccounted-for Gas;" and the second and third premiums to Mr. Lewis T. Wright and Mr. C. Stafford Ellery respectively.

Half an hour after the time fixed for the commencement of the meeting, the President found the way clear for the delivery of his Inaugural Address, which was attentively followed by an audience that filled the hall of the Society of Arts to its utmost capacity.

The President's address ran to a considerable length; but it was commendably free from "padding," and deserves to be attentively read by all followers of the gas industry, especially on the commercial side. The first portions of it had nothing to do with gas making, but dealt exclusively with the relative positions of the gas and electric lighting industries, the price of coal, the value and sale of sulphate of ammonia, and the reasons that might be regarded as sufficient to induce gas undertakings to distil their own tar. The President's observations throughout are clear, incisive, and carry conviction with them; and his arrangement of his topics in order is systematic and helpful to the understanding of his hearers. With regard to the comparative positions and cost of gas and electric lighting, the presidential argument is even startlingly symmetrical in its statement of the general, and the reinforcement of this by the particular illustration drawn from the case of Nottingham. Starting with the grand totals of the national gas and electric lighting statistics, the President quickly showed that "the total output of electricity for the whole country is little more than one-half the normal progressive increase in the consumption of gas for one year; or, to put it in another way, nearly two additional installations of electric light plant of equal magnitude to the existing one would have to be put down each year before the normal annual growth in the consumption of gas would be arrested, and any serious competition be felt." He then proceeded to examine how far the local experience of Nottingham bears out this comparison; and after incidentally proving, by calculation and the evidence of accounts, that electric current for lighting costs the customers of the Nottingham Corporation about two-and-three-quarters the price of gas (to say nothing of the cost of the lamps), the remarkable fact was brought out that in Nottingham it would "require the establishment of rather more than two such electric lighting installations as that already in existence to be put down each year simply to arrest the yearly increase in the demand for gas, before there would be any interference with the normal business of the gas undertaking." This was very cleverly led up to.

A comparison of the capital cost of gas-works as compared with a central electric lighting station, and of the result of carbonizing, as compared with burning, coal

to generate electricity, led to another illustration—also from Nottingham—of the most economical style of production of the electric light. All this part of the address was so carefully and thoroughly worked out, that the subjects treated may be regarded as settled, so far as controversy is concerned, for the time being. We are especially grateful to the President for thus grappling with a set of questions respecting which many inquiries are constantly coming to us from correspondents who appear to be yet in ignorance of what a Board of Trade unit of electricity means in practice. Henceforth we shall refer all such puzzled individuals to this presidential address, with the suggestion that, if they fail to comprehend the subjects after reading these lucid explanations, they had better seek what is significantly termed "advice."

The address then broke into a different subject—the price of coal and the commercial relations between the colliery and the gas interests. The President confessed that the "cut-throat competition" which is actually forcing down the value of coal to a point at which it is unremunerative to the proprietor and the worker, is a great evil. He agrees with his fellow-President of the Association of Mining Engineers that these low prices are the result of an excessive output; and he endorses the observation often advanced in the "JOURNAL," that what the gas industry would prefer is rather a stable than an unduly low price for the raw material. "We should be well content if an understanding could be come to between masters and men by which the price of coal could be fixed at a stable figure, such as to ensure a reasonable profit to the one and fair remuneration to the other." But, unhappily for the prospect of a realization of this amiable desire, competition is the Cæsar to which all non-statutory trades in this country have appealed; and from the consequences of this ultimate procedure there is no escape. The subject of coal prices led the President naturally to the consideration of the market value of sulphate of ammonia; and once more it was declared that the market has been ruined by the lack of concerted action among producers, and by business incapacity on the part of "certain manufacturers." The voice of Nottingham speaks in this regard in the same sense as that expressed over and over again in our columns. Makers are urged to "resolutely set their faces against selling portions of their make forward; to put the material on the market as it is produced; and to endeavour to cultivate the home trade with the consumers direct, or with the local manure manufacturers." Unfortunately, most of those who would hear and give heed to the President of The Gas Institute in this regard, speak he never so wisely, are comparatively small producers who can only exert any good effect by acting upon the last recommendation. It is "certain manufacturers" whose operations are large enough to seriously affect the market who need instruction; and they are a law unto themselves. For this, among other reasons which need not be gone into here, the President's desire to revivify the Sulphate Manufacturers' Association is not likely to be gratified.

The price of tar and its products presents itself to Mr. Chester, who is a distiller, in a better light than that which renders the darkness of the sulphate market visible. He approves of the sale of tar by gas undertakings on a sliding-scale; and he is justified in holding the opinion that where this arrangement can be concluded, it is a preferable expedient to what he terms the "arbitrary step" of establishing distilling works, and thereby increasing the responsibilities of gas-works management.

Coke is treated in the address like the "drug" it is in the fuel market. The President had nothing very reassuring to say upon this topic, with the exception of offering the prudent advice to "specialize" in coke production. It is probably time that, by preparing a description of coke specially to suit the different requirements of consumers, a better average price for the whole product can be obtained. So it appears that a particular brand of the commodity termed "Nottingham cut coke" has a widely extended sale. In this connection, it would have been interesting if the President had given his views respecting the suggestion to introduce carbonizing plant on the coke-retort principle into gas-works of sufficient size, and well situated for disposing of dense varieties of the product.

The views expressed in the address respecting the general problem of economical and efficient carbonization are eminently sound. The President placed the subject of mechanical aids to drawing and charging retorts upon a safe footing by stating that, while retort-stoking machinery has taken several phases during the past twenty years, it has never, except in the early stages, been abandoned for a return to hand work. This is the true test of success. Mr. Chester had no hesitation in pronouncing against the inclined retort system as compared with horizontal retorts worked by power machinery. It was a declaration that had not previously been so uncompromisingly made upon competent authority. Hitherto, both mechanically stoked horizontal retorts and inclined retort systems have been placed before the technical public with many complications of effects which have obscured the essential points on which both systems must in the long run stand or fall. Nowhere, that we can recall in the instant, has the practical problem of efficient and economical carbonizing been stated for solution absolutely without prejudice or regard to adventitious circumstances. Mr. Chester has now committed himself to the statement that, all things being equal, horizontal retorts with power machinery bear away the palm from their sloping rivals; and the statement will hold good until it is disproved. Though the President does not expressly mention the point, it is in all probability the question of rate of gas production that has been determined by him adversely to the inclined retort system. Further light on this point would be welcomed. It is to be hoped that future writers upon either side of the question will be careful to separate the element of carbonizing pure and simple from the disturbing influences of firing and coal handling.

Carburetted water gas came in for some guarded presidential approval. It is admitted that under ordinary conditions there is not much, if any, saving in the production of the finished carburetted water gas, but that it has many other recommendations. The President, however, observed that, though carburetted water-gas plant is likely to find a welcome in every large and moderate-sized gas-works, "there does not appear to be the same scope for it in works of smaller magnitude, unless it be accompanied by a large increase in the storage accommodation for gas." This is rather a hard saying, inasmuch as ready production in bulk is supposed to be one of the chief advantages of this kind of gas-making plant.

It is good to have the President's declaration that "no other portion of a gas-works offers so much scope for a reduction in the cost of production as the retort-house." This is only another way of saying that profits are made in the retort-house, which is unquestionably one of the foundation rules of good gas managership. Stupid administration, lack of commercial ability and business faculty, together with the encouragement of an arbitrary, dictatorial spirit at head-quarters, may bring a gas undertaking into discredit, and cause the loss of much money. But unless the carbonizing is reasonably well done, there will be little or no profit to lose. It is especially necessary that the technical societies connected with the gas industry should be kept in remembrance of this cardinal point in gas manufacture; for while they can do little to influence the financial standing and commercial success of gas undertakings, they can at any rate bring out and promulgate sound carbonizing principles among their members.

Economies, of course, can be effected throughout every department of a gas-works; and the President did not omit due acknowledgment of what it is possible to save by improved methods of treating gas subsequent to its production. The mention of improvements in gasholder construction served to introduce a description of a remarkable historical relic of certain wooden gasholders nearly half-a-century old, built for the Seaham Harbour Gas-Works, which we do not remember to have seen noticed in any memoir on the subject. This description was illustrated by an exhibit consisting of a "sample piece of one of the side timbers, which, since it ceased to be a component part of a gasholder twenty years ago, has done duty as a fence." What a remarkable overlapping of eras is disclosed in this statement! Geologists and anthropologists have long familiarized the world with the idea of marking the passage of undated time by the character of the relics of human handiwork supposed to be appropriate to definite periods, as the "palæolithic," "neolithic," and "bronze" eras, and so forth. If one had been asked to what era of development of gas manufacture wooden gasholders belonged, the reply would naturally have been, on general principles, that such a system of construction could only

have been contemporaneous with Accum and Peckston; yet the examples mentioned in the presidential address were taken out so recently as 1875.

The President made a brief, but weighty, reference to the progress realized in the popularization of gas by means of the coin-freed meter. On this topic he remarked that "it is marvellous to witness the eagerness with which the working-class population take up this prepayment system of supply, and how they cling to it when the gas is once laid on. Apparently it raises their social status, and carries with it many comforts and conveniences to which they have long been unaccustomed." The wording of the last sentence is curious, and gives food for reflection.

A very serious portion of the address followed these comparatively light paragraphs. It was concerned with the vastly important question of the incidence of the burden of capital in the respective cases of private and municipalized gas undertakings. Mr. Chester's treatment of this subject was naturally tinged with his own local colouring; but his demonstration of the rapidity with which Municipalities are getting the better of Companies in this respect, is worthy of the closest attention on the part of those who are solicitous for the future of gas supply by private enterprise. We must refer our readers to the original text for further information respecting Mr. Chester's views, which have much to commend them.

The concluding portion of the address was devoted to setting forth the claims of the Benevolent Fund upon the charity of members of the Institute—a cause that has never been otherwise than pressingly argued for in the "JOURNAL," as the President freely conceded. If the fund has fallen upon evil times, the circumstance is to be regretted; but the reason is not far to seek. The President could do no more than call upon the present members of the Institute to carry on the work commenced mainly by other hands in the past; and the failure of his appeal would go very strongly in support of the contention that a radical reconstruction of the organization of the Fund, to meet the changed circumstances of the Institute, is expedient.

The pleasing duty of moving and seconding a vote of thanks to the President for his address was well performed by Mr. William Carr and Alderman Miles, whose words did not go beyond the general appreciation of the presidential utterance by the members. But Mr. Chester would probably feel more flattered by a substantial addition to the resources of the Benevolent Fund, as the direct result of his appeal, than by any verbal compliments.

We shall not attempt to comment here upon the various papers submitted to the meeting, as a better opportunity for doing so will occur after their text and our report of the discussions have been published. Suffice it to say, in general terms, that the efforts of the writers were thoroughly appreciated by their auditory, and that all the discussions, without exception, were well sustained. As will have been perceived by the programme, the Institute was bidden to three solid days' work, with only the interlude—which was no interruption—of a *conversazione* on the Wednesday evening at the Westminster Town Hall. This was a thoroughly successful function, and was much enjoyed by the large party who assembled to do honour to the President, notwithstanding the inclemency of the weather.

Mention must be made here of the success of the lecture by Professor Frank Clowes, on mixtures of inflammable gases and air, which was one of the leading features of the meeting. The lecture had been most carefully prepared, and was illustrated with numerous fresh and pertinent experiments and demonstrations. It led up to, and served to introduce to the meeting the ingenious and valuable instrument known as "Redwood's Inflammable Vapour and Gas Detector"—an apparatus which has been already described in our columns, and which, if freely and properly used, should be efficacious in diminishing the risk of trouble from gas explosions in electric street culverts and other places.

The formal business of Thursday afternoon was of exceptional interest. The Institute has found in Mr. C. Stafford Ellery, of Bath, an acceptable successor to Mr. Chester in the presidential office; and the almost inevitable selection of Bath as the place of meeting for next year seemed to be highly popular. Mr. Stelfox and Mr. Samuel Stewart are the new Vice-Presidents—an unexceptionable choice. In making the presentation of a handsome piece of plate to Mr. Joseph Hepworth, in accordance with the vote at last year's meeting, the Institute fittingly acknowledge services of inestimable value to the organization; for it is undoubtedly to Mr. Hepworth and a few others who associated themselves with him, as they would barely have rallied to anybody else, that the existence of the Institute to-day is mainly due. A well-deserved testimonial was also presented to Mr. F. G. Burfield, the late Secretary of the Institute; and with the usual coruscation of complimentary votes, the formal meeting of the Institute for 1896 came to an end amid general congratulations.

The excursion to the Nore Light and Sheerness on Friday duly came off as arranged, and was well patronized.

REPORT OF PROCEEDINGS.

The Thirty-third Annual General Meeting of the Institute was held on Tuesday, Wednesday, and Thursday last week, at the Society of Arts, John Street, Adelphi, under the presidency of Mr. W. R. CHESTER, M.Inst.C.E., of Nottingham.

A WELCOME BY THE PRESIDENT.

The PRESIDENT, in opening the proceedings, briefly welcomed the members; remarking that, when they met in the Provinces, this duty was usually discharged by the Mayor or someone in authority.

CONFIRMATION OF MINUTES.

It was then agreed to take the minutes of the previous meeting as read.

APPOINTMENT OF SCRUTINEERS.

Mr. W. Whatmough (Heywood) and Mr. John Morton (Ashford) were appointed Scrutineers of the ballot-papers.

THE COUNCIL'S REPORT.

The SECRETARY (Mr. Walter T. Dunn) then read the report of the Council, which was summarized in the "JOURNAL" for the 26th ult. (p. 1169).

Mr. T. BOWER (West Hartlepool), in moving the adoption of the report, congratulated the Council on the healthy state of the Institute, as shown by the increase in the membership. He expressed regret that the meeting was not being held at the Institution of Civil Engineers, as usual of late years, but said he had no doubt there were good reasons for the change.

Mr. W. W. HUTCHINSON (Barnsley), in seconding the motion, said he was pleased to think there was a likelihood of having an equally, or even more, encouraging report on the next occasion.

Mr. J. BOOTH (Southport) said all the members would reciprocate the congratulations of the Council on the satisfactory nature of the report. Considering the exceptional expenditure which had had to be incurred for several years, it was very gratifying to find that they had turned the corner, and that the balance was on the right side.

The PRESIDENT, in putting the motion, explained that when application was made, some months ago, to the Institution of Civil Engineers, for the use of their hall, it was found that it was already engaged on the dates required; and, as an alternative, the Council thought they could not do better than obtain the use of the hall of the Society of Arts, in which the Institute and their predecessor, the British Association of Gas Managers, held their meetings for many years.

The motion was carried unanimously.

THE ACCOUNTS.

Mr. ISAAC CARR (Widnes) moved the adoption of the accounts as submitted.

Mr. C. A. CRAVEN (Dewsbury), in seconding the motion, said he could not help contrasting the present accounts with those for the year 1864. He thought they had every reason to be proud of the progress which had been made. Not only had they "turned the corner," but had gone a considerable way along the next street—the one leading to prosperity.

The PRESIDENT expressed the satisfaction of the Council in being able to show so large a balance as £86 on the accounts for the year. He believed, with Mr. Craven, that they had got a long way beyond the turning-point.

The motion was agreed to.

Premiums for Papers.

The President then announced the awards of premiums for papers read at the last meeting, as follows:—

First Prize (with the President's Medal).—To Mr. D. Irving, of Bristol, for his paper on "Unaccounted-for Gas."

Second Prize.—To Mr. Lewis T. Wright, for his paper on "Matters of Interest in Connection with the Washing of Crude Coal Gas."

Third Prize.—To Mr. C. Stafford Ellery, of Bath, for his paper on "Some Improvements in the Methods of Manufacturing Sulphate of Ammonia."

The first and third prizes were presented to the recipients by the President with a few appropriate remarks in each case, and briefly acknowledged. Mr. L. T. Wright was not present.

President's Address.

The President then delivered his Inaugural Address, which was given in the "Journal" last week (p. 1260).

Mr. W. Carr (Stalybridge) proposed a vote of thanks to the President for his address. He said there might be differences of opinion on some of the points referred to therein; but everyone would agree that it was full of suggestions and useful data, which could not fail to be helpful to many. The Institute had had a long line of Presidents, many of whom had been among the foremost of gas engineers; but they might congratulate themselves on having a President who in no way derogated from the honour and dignity of the office. He had much pleasure in moving the vote of thanks to him.

Alderman Miles (Bolton), in seconding the motion, said the address they had heard would rank as one of the ablest which had ever been delivered either before the Institute or the British Association of Gas Managers. Innumerable matters of pressing moment had been brought before them, which had not only been listened to with the greatest attention, but would be studied with great profit in the quiet of many a gas manager's office during the next few weeks. If they could not claim Mr. Chester absolutely as a "Lancashire lad," they could do so to a great extent, for a large part of his experience had been gained in Lancashire; and everyone there was proud of the position he now occupied. They would all wish him long life, and continued opportunity for usefulness.

The resolution having been put by Mr. Carr, and carried by acclamation,

The President briefly responded. He said he was fully conscious of the responsibility attaching to the important position he occupied; but he hoped, with the aid of the members, to so conduct the business of the meeting that it should compare as favourably as possible with its predecessors.

The meeting then adjourned for luncheon.

Reading of Papers.

On the resumption of the proceedings in the afternoon, the reading of papers was commenced. These and the lecture were taken in the following order:—

Tuesday.—(1) "New Details in Gasholder Construction." By E. Lloyd Pease, of Stockton. (2) "Gas-Engines as Economical Motors." By J. Holliday, of Scarborough.

Wednesday.—(3) "Explosive Mixtures of Combustible Gases with Air, and Methods for Detecting and Measuring Minute and Dangerous Proportions of such Gases." Lecture by Professor Frank Clowes, D.Sc. Lond., F.I.C., of Nottingham. (4) "Principles Governing the Transfer of Gas Undertakings." By E. H. Stevenson, of Westminster. (5) "Letting Gas Apparatus on Hire." By Norton H. Humphrys, of Salisbury. (6) "The Popularization of Gas." By A. Dougall, of Tunbridge Wells.

Thursday.—(7) "A Standard Photometer." By W. J. Dibdin, of London. (8) "Photometers and Standards of Light." By W. Sugg, of Westminster. (9) "A Season's Experience with Incandescent Public Lighting." By F. G. Dexter, of Winchester.

We give to-day the first five papers in the above list, with a report of the discussion on Mr. Pease's paper and a summary of Professor Clowes's lecture. The rest of the technical matter will appear in succeeding issues.

Report of the Scrutineers.

On Thursday afternoon, the result of the balloting for the election of office-bearers for the ensuing year was declared, as follows:—

President.—C. Stafford Ellery, of Bath.

Vice-Presidents.—J. Stelfox, of Belfast; S. Stewart, of Greenock.

New Members of Council.—Isaac Carr, of Widnes; W. F. Cotton, of Dublin; S. S. Mellor, of Northwich; G. Winstanley, of Coventry.

Auditors.—Alfred Lass, F.C.A., of London; T. H. Martin, of New Barnet.

Hon. Secretary.—A. Dougall, of Tunbridge Wells.

Benevolent Fund Committee.—B. Green, of Mitcham; T. T. Marks, of Llandudno.

New Members.

It was announced that all the gentlemen whose names appear in the following list of applications for admission to the Institute had been approved, and would be duly enrolled; and the transference of an associate to the class of members was sanctioned by the meeting.

Members.—Burfield, F. G., Tunbridge Wells; Cheyne, W., Briton Ferry; Collins, G. A., Dudley; Coombes, A. E., Ryde (I.W.); Cornish, J. H., jun., Bridport; Dougall, J., Hoylake; Dougall, W. J., Sevenoaks; Duncan, G. H., New Tredegar; Ewing, W., Hamilton; Herring, W. R., Huddersfield; Ingram, S. J., Truro; M'Coll, J., Halesowen; Prince, W., Stoke-on-Trent; Ruxton, W. M., Berwick; Smith, A. H., Darwen; Temblett, S., Andover; Walton, W. E., Bishop Auckland; West, R., Hebden Bridge; Witten, J., Great Yarmouth; Wynne, F. W., Milnthorpe.

Associate Members.—Buckland, W. T., Chesterfield; Bunyar, E. F., Belfast; Clarke, S. G., Nottingham.

Associates.—Braddock, G. H., Oldham; Coates, T., Darlington; Nuttall, J., Oughtibridge; Stewart, T., Glasgow.

Transference.—Associate Member to Member: F. Gibson, Chelmsford.

Presentation to Mr. Hepworth.

The President then read the resolution passed at the last annual meeting, authorizing the Council to appropriate such sum as they thought fit to showing in some tangible manner the high appreciation of the members of the Institute of Mr. Hepworth's services as Honorary Secretary. He said the Council had carried out this resolution by providing a handsome silver bowl, which might be used either to contain punch or for a variety of other purposes; and he hoped this would convey in some slight degree the feelings of the members towards Mr. Hepworth, and their appreciation of the services he rendered so admirably during a critical period in the history of the Institute. Those who were members of the Council during the time Mr. Hepworth held office knew how much the present position of the Institute was due to his efforts; and he could only say, speaking from personal knowledge, that they were absolutely invaluable. He had much pleasure in handing him, as a slight token of esteem, that silver bowl, bearing on one side his initials, and on the other the inscription:—

Presented to J. Hepworth, Esq., M.Inst.C.E., in recognition of his services as Honorary Secretary of the Incorporated Gas Institute, June, 1896.

Mr. Hepworth, in acknowledging the gift, said he must first apologize for his absence from the meetings to a much greater degree than he could have wished; but his excuse must be that he had been detained in another place. He thanked the members from the bottom of his heart for their very valuable present; but he could not take to himself the credit which had been awarded him in the graceful words of the President, and cordially assented to by the meeting. He was elected to office at a particular time; and he only did what any other member would have done—the best he could to further the interests of the Institute at that time. He did not hold the office very long; and the largest amount of work which fell on him was that which resulted in the present constitution of the Institute. As they were aware, the Institute sought the

assistance of the Solicitor to the Institution of Civil Engineers. On his advice, the present constitution was framed; and he believed it would stand as a tribute to that gentleman's wisdom and ability as long as the Institute lasted. He had to thank the members for the hearty co-operation he received during the time he held office, and especially the Past-Presidents, the late Secretary, and all the members of the Council. Their aid had rendered the discharge of his duties both easy and pleasant. He had been privileged, during the few years over which his office extended, to see the Institute grow in prosperity in every way, both in numbers and in usefulness; and he had also noticed a very large restoration and increase of good feeling among the members, which he trusted would continue and develop in the future to a still greater extent. He should be sorry to have to leave the ranks of the Institute; but if at any time the altered position he now occupied should necessitate such a step, he should cheerfully take it—seeking rather the good of the Institute than any personal gratification to himself. So long as he remained a member—which he hoped would be as long as he lived—they might feel quite sure that he should never use his position for any personal ends, but should endeavour, as they all would, to further the interests of the profession to which they belonged. He should value this testimonial as long as he lived, and so would those who came after him. His feelings were somewhat tinged with regret, for he greatly missed the kind friend who first acquainted him with what had been done at the meeting in Edinburgh—Mr. Denny Lane; and he was very glad to find that, in the opening address of the President, as well as in the report, a permanent record had been made of the great services rendered by Mr. Denny Lane to the Institute. On such an occasion, many words were not required; and when the heart was full, perhaps the fewest were the best. But he would just add one to what he had said. This beautiful specimen of the silversmith's art would speak to him in the future, not of any work he had done for the Institute, but of that which the Institute had done for the gas industry, and would remind him of the friendships he had there formed, and of the kindness he had received from all its members; and those would be some of the happiest memories of his life, however long it might be protracted.

Presentation to Mr. Burfield.

The President said he had still another pleasing duty to perform. Unfortunately, the Institute lost in one year both their Honorary Secretary and also their Secretary; the latter gentleman having succeeded to a much more remunerative appointment. They could not but congratulate him on his success; and the Council at a recent meeting decided unanimously to put into some permanent shape a resolution expressing their appreciation of the services Mr. Burfield had rendered. It had taken the form of an illuminated address in the following terms:—

At a meeting of the Council held at the offices of the Institute, 13, Victoria Street, Westminster, on September 27, 1895, the following resolution was passed unanimously: "That the Council of The Gas Institute have received with great regret the resignation of Mr. Frederick G. Burfield of his position as Secretary of The Gas Institute which he has held for the past three years. The Council congratulate Mr. Burfield on his new appointment as Assistant-Secretary of the Tunbridge Wells Gas Company, and wish to record their appreciation of the valuable services he has rendered to the Institute during the time he has occupied the post of Secretary; they also desire to express their complete satisfaction with the admirable manner in which the business of the Institute has been conducted by him."

This was signed by the President and the Honorary Secretary; and he (the President) had much pleasure in handing it to Mr. Burfield.

Mr. Burfield, in returning thanks, said he had conscientiously tried to do his duty while holding the position of Secretary; and it was very gratifying to him to find that his efforts had been appreciated. He was proud to say that he was not altogether severing his connection with the Institute, inasmuch as he had, by their kindness, just been elected a member; and he hoped to have the pleasure of attending the annual gatherings for many years to come.

Votes of Thanks.

Mr. H. Lees (Hexham) proposed a vote of thanks to the authors of the papers; remarking that he believed their contributions to the Transactions would rank as high as any of their predecessors.

Mr. J. Andrews (Langley Mill) seconded the motion, which was carried unanimously.

Mr. S. Y. Shoubridge moved a vote of thanks to the Scrutineers.

Mr. J. Braddock (Radcliffe) seconded the motion; and it was at once carried.

Mr. Whatmough and Mr. Morton acknowledged the compliment; the latter gentleman remarking that, if members would only read the instructions on the ballot-papers, the work of the Scrutineers would be very considerably lightened.

The President said he should like to emphasize the appeal Mr. Morton had made. He was sorry to say that no less than 75 ballot-papers had had to be rejected from failure to obey the instructions.

An Honorary Member.

The President then moved that the President of the French Society of Gas Engineers for the current year be elected an Honorary Member of the Institute. He said this was a resolution which was passed every year—the French Society reciprocating the compliment.

The motion was carried unanimously.

Place of Next Meeting.

Mr. David Terrace (Middlesbrough) proposed that the next place of meeting be Bath. He said he thought this would be a compliment to the newly-elected President, and would be very pleasant to the members.

Mr. R. Hunter (Chester) seconded the motion.

Mr. Morton suggested that it was not always desirable that the meeting should take place in the city or town in which the President resided.

No other place being proposed as an alternative, the motion was carried unanimously.

Mr. Ellery thanked the members for the honour they had conferred upon him that day—one which he did not think he could have dared to accept but that during the past twenty-two years he had observed that the members had been very sympathetic and considerate to their Presidents; and he took this opportunity of asking them to show the same kindly feeling towards him in the coming year. One point in which they could materially assist him was by volunteering papers. Gentlemen who were known to be working on some special lines were sometimes asked to prepare papers. But there must be many others who were working in their own towns in some special direction; and a knowledge of their results would be of much benefit to the Institute, while the discussions which would arise might be of advantage to themselves. With regard to the meeting being held in Bath, he had refrained from saying anything until the vote was taken, because he felt some misgivings as to whether Bath was important enough for such an honour. But the decision having been come to, he could only say he would do all in his power to make the meeting a successful one.

The President said he sympathized very much with the appeal Mr. Ellery had made with regard to papers. Members were sometimes rather inconsiderate; and, after having promised papers, left the President "in the lurch" by announcing at the last moment that they were unable to get them ready. This had been his experience at the present meeting; and it was only a repetition of what had taken place before. It would relieve the President of much anxiety if members would volunteer papers.

Thanks to the Council, President, Auditors, and Honorary Secretary.

Alderman Miles moved that the cordial thanks of the Institute be given to the Council for their valuable services during the past year. They had, he said, a great deal of detail work to do; and the flourishing state of the Institute was largely due to their efforts.

Mr. J. Booth (Southport), in seconding the motion, said the duties of the Council were increasing from year to year; but he trusted the same energy which had carried them through in the past would be evinced in the future.

Mr. Isaac Carr supported the resolution. He congratulated the Council on the excellent programme provided for the meeting, and desired to suggest that much of its success was due to the fact that the papers had been

fewer in number than on many previous occasions—thus allowing more opportunity for discussion.

The motion was carried unanimously.

Mr. J. Stelfox (Belfast) next moved a vote of thanks to the President, whose able conduct in the chair had, he said, entitled him to rank with anyone who had preceded him.

Mr. H. Tobey (Malton) seconded the motion, which was carried by acclamation.

The President, in responding, said if the meeting had been successful, it was largely due to the assistance he had received from the members of the Council, who had done all in their power to lighten the burden upon him, and especially from the Honorary Secretary.

On the motion of Mr. R. Porter (Elland), seconded by Mr. R. G. Shadbolt (Grantham), a vote of thanks was accorded to the Auditors.

Mr. T. H. Martin (New Barnet) briefly responded.

Mr. W. Carr said he had to propose one of the most important resolutions of the day. It was a vote of thanks to the Honorary Secretary—an official upon whom a great deal of the success of such an institution as theirs must depend. Presidents came and went; but the Honorary Secretary held a more permanent position, and his qualifications were really more important. Mr. Dougall was always kind and courteous to everyone; and he (Mr. Carr) had no doubt the success of the meeting was largely due to his valuable, though unobtrusive, services.

Mr. P. Simpson (Rugby), in seconding the motion, ventured to express the hope that it would be a good while before they had to give Mr. Dougall a testimonial on his resignation.

The President, in putting the motion, said he felt last year, when Mr. Hepworth resigned, that his loss would be almost irreparable. But time had proved that Mr. Dougall was a most efficient successor. Mr. Carr had said he was "always kind and courteous;" and he (the President) added that, like Phyllis, our "only joy," he "never fails to please."

The resolution having been carried unanimously,

Mr. Dougall, in reply, said any services he had been able to render to the Institute had been a great pleasure to him; and he was glad to find that his efforts had been appreciated. The Institute had a great work before it; and he should be only too pleased if he were able to do anything to forward its objects.

The proceedings then terminated.

The Benevolent Fund.

At the conclusion of the business on Tuesday afternoon, a meeting of the Donors and Subscribers to the Benevolent Fund was held—the President in the chair.

The Secretary read the minutes of the last meeting, which were confirmed.

The report, which had been previously circulated among the members, was taken as read.

Mr. T. Bower (West Hartlepool) moved the adoption of the report and accounts. He remarked that he need only say there had been no new calls this year, which had placed the funds in a somewhat better position. For many years there had been several applications, which could not be dealt with in as liberal a manner as the Committee would have liked; but this year there had only been renewals to those already on the books, which was matter for congratulation.

Mr. P. Simpson (Rugby), in seconding the motion, said he was sorry to see so small a gathering, especially after the appeal made by the President in his Inaugural Address that morning.

Mr. J. Morton (Ashford) supported the motion, and suggested that the Council should circulate in a special pamphlet that part of the President's address which referred to the Benevolent Fund. He thought it was not on account of want of interest on the part of members that they did not contribute, but because the matter was not sufficiently brought before them.

Mr. F. Lennard said he had been a member of the Institute since 1881, but had not yet subscribed to the Benevolent Fund. However, after the remarks of the President that morning, he should be pleased to add his name for a guinea per annum.

The President said he was rather disappointed to find so small a meeting; but no doubt it was in a great measure due to modesty on the part of members of the Institute, who did not feel they had any right to be present as they did not happen to be subscribers. He hoped, if Mr. Morton's suggestion were adopted, that many more would subscribe, and that on a future occasion they would have a much larger meeting. He was not quite sure that the smallness of the gathering was not partly due to the time at which it was held, after the conclusion of the day's business, when members were exhausted, and anxious to get away. He was happy to say that they had had one or two donations during the present year, and that there was a balance on the right side; but this simply arose from the fact that there had been no new applications. A sum of £102 had been distributed among those who had formerly received assistance. He wished to add that any member of the Institute who was a subscriber could ascertain the exact facts as to the help given in any particular case, although care was taken, for obvious reasons, not to publish the names of the recipients. He thought the fund should be raised to at least £2000, so that from the interest derived and the annual subscriptions quite £214 a year might be placed at the disposal of the Committee for distribution. Members who happened to know of any deserving cases should place them before the Committee, so that they might deal with them as promptly as might be, and as liberally as the funds would permit.

The motion was then put and carried unanimously; and the meeting separated.

THE LECTURE.

EXPLOSIVE MIXTURES OF COMBUSTIBLE GASES WITH AIR,

AND

METHODS FOR DETECTING AND MEASURING MINUTE AND DANGEROUS PROPORTIONS OF SUCH GASES.

By Professor Frank Clowes, D.Sc. Lond., F.I.C.,
University College, Nottingham.

Explosion of Combustible Gases.

Every combustible gas, when it is burnt in air, develops a certain amount of heat, and yields certain gaseous or vaporous products. The gas can only burn as air is supplied to it. Hence, if the gas is kindled at the mouth of a vessel, it will burn only where it comes into contact with the air. If, however, the gas has been mingled with air before being kindled, it may be enabled to burn rapidly throughout its mass, without obtaining a supply of air from outside.

When a mixture of combustible gas and air burns rapidly throughout its mass, the heat developed is stored for a time in the products. These products become increased in volume by the heat, and occupy a volume considerably larger than that of the original mixture of gas and air. Hence the kindling of such a mixture in the open gives a large flare; while in a confined space, it produces pressure, and possibly explosion.

Those gases which create the highest temperature by their combustion, will produce the greatest pressure or explosive effect when they are burnt in a state of mixture with air. One gas at least adds to the explosive effect produced by its combustion, that due to heat created by the decomposition which accompanies its combustion. This gas—acetylene—is therefore competent to produce unusually powerful explosive results.

It is noteworthy, and is easily demonstrated by experiment, that the cool products of explosive combustion of a mixture of coal gas and air occupy less space than the mixture did before its combustion. In the case of coal gas, the volume of the cool products is little more than three-quarters that of the original explosive mixture. This contraction of volume of the products in cooling is largely due to the steam which has been formed during the combustion condensing to water. Such a contraction occurs in the case of every combustible gas containing hydrogen as a constituent; and it is therefore a very general result.

Explosive Limits of Combustible Gases.

The proportion in which air is mingled with the combustible gas, has very considerable effect upon the explosive nature of the mixture. When the gas is present

in a certain proportion in the air, the explosive effect produced by kindling the mixture is a maximum. The explosive effect is lessened when this proportion of gas is either increased or diminished; and when the proportion of gas is increased or decreased to a certain extent, or limit, the mixture cannot be kindled and burnt explosively.

The lecturer mentioned the upper and lower limits for certain important combustible gases. The lowest and highest percentages of each gas which were explosive in air were stated, as they had been fixed by his own experiments. The experiments were made with mixtures in varying proportions of each combustible gas with air. A flame was brought into contact with each mixture, sometimes above and sometimes below; and it was noted whether the mixture burnt back independently of the external air. For each combustible gas, there was thus obtained a lower percentage, below which the mixture would not burn independently, and a higher precentage, above which the mixture burnt only when it was supplied with more air. The limiting precentages were as follows: For methane or marsh gas, 5 and 13; for hydrogen, 5 and 72; for carbon monoxide, 13 and 75; for ethylene, 4 and 22; for water gas, 9 and 55; for coal gas, 5 and 28; and for acetylene, 3 and 81. It was also proved that many mixtures which were outside but close to the above limits, and which could not be fired from above, could be fired from below. Hence it is inferred—

1.—That the limiting explosive mixtures for different combustible gases vary widely in composition.
2.—That methane shows the narrowest limits, and hydrogen the widest limits.
3.—That the risk of a mixture being fired explosively increases with the different gases in the following order: Methane, ethylene, coal gas, water gas, carbon monoxide, hydrogen.
4.—That the risk of explosion occurring is greater when the mixture is kindled from below than when it is kindled from above.

In the case of mixtures of Nottingham coal gas with air, which are exposed to contact with a flame applied beneath, explosive firing begins when 5 per cent. of gas is present; it reaches a calculated maximum with 14 per cent. of gas; and explosive firing ceases when 28 per cent of gas is in the air. If, however, the kindling flame is applied beneath the mixture, explosive firing does not commence until 9 per cent. of gas is present, and it ceases with 22 per cent. The coal gas used in these experiments was the Nottingham town supply. An analysis made by the lecturer at the time of its use showed that the gas contained the following percentages of its constituents:—

Composition of Nottingham Coal Gas.

Olefine hydrocarbons	5·3
Oxygen	0·2
Nitrogen	5·5
Hydrogen	48·2
Carbon monoxide	6·6
Methane, or marsh gas	34·2

The water gas was found to have the following percentage composition:—

Composition of Water Gas.

Hydrogen	49·6
Carbon monoxide	40·8
Carbon dioxide	2·6
Nitrogen	7·0

This liability of mixtures of combustible gas with air to explode when they are kindled, constitutes a danger which is familiar to those who have to deal with coal gas and with the different forms of gaseous fuel. In order to guard against danger, it becomes necessary to watch carefully for escapes of such combustible gases into air-spaces which are more or less confined, and especially to guard against all risks of such mixtures being kindled.

Poisonous Constituent in Coal Gas, Gaseous Fuel, and in the Products of their Incomplete Combustion.

But there is another danger besides the explosive force attendant on the burning of such mixtures. If the gases contain carbon as a constituent—as all ordinary illuminating and heating gases do—there is a possibility of the products of combustion or of explosion being rendered poisonous by the presence in them of carbonic oxide gas. This danger arises only when the combustion of the gas has been incomplete. Incompleteness of combustion may arise from deficiency of air or from contact of the flame with chilling or cooling surfaces. The consideration of danger from poisoning by breathing air containing carbonic oxide arises, however, not only in connection with the products of incomplete combustion of these gases, but also in connection with the gases themselves before they are burnt.

Water gas is highly poisonous when breathed; it contains as much as 40 per cent. of carbonic oxide. Producer gas, Dowson gas, and other gaseous fuels contain somewhat less of this poisonous gas; but even coal gas, with about 6 per cent. of carbonic oxide, is poisonous, and becomes still more so when it has been enriched by the use of water gas.

Detection and Measurement of Carbonic Oxide.

Air may accordingly become poisonous by the escape into it of illuminating or of heating gas. Many of these gases possess no characteristic smell; and their presence in the air would therefore not be evident to the senses. It is even stated that coal gas, which is usually readily detected by its smell, may be deodorized by its passage through certain kinds of soil, and might therefore be present in the air unperceived. Under these circumstances, it often becomes necessary to be able to test for the presence of these gases in the air. A test for inflammable gases generally will be subsequently described. This test detects even the minute proportion of carbonic oxide in air which gives rise to danger; but it does not serve to discriminate between the different kinds of combustible gas, many of which are not at all poisonous.

Dr. J. S. Haldane has, however, furnished a means of testing air for carbonic oxide, which is of easy application. With a little care, it serves also to measure the proportion of carbonic oxide present in the air. It depends upon the fact that blood diluted with one hundred times its volume of water changes colour from pale-brown to pink, when it is shaken with air containing carbonic oxide. So small a quantity as 0·1 per cent. of carbonic oxide in the air may be detected and measured by properly applying this test. The full particulars of this method, and of the means of detecting inflammable gas, will be found in a book by the lecturer on "The Detection and Measurement of Inflammable Gas and Vapour in the Air," which is now in course of preparation by Messrs. Crosby Lockwood and Son.

Dr. Haldane finds that the presence of 2 per cent. of carbonic oxide in the air renders such air very poisonous, and rapidly fatal when it is breathed. The presence of even 0·2 per cent. produces symptoms of poisoning, and may, under certain conditions, prove fatal. Hence extreme care is necessary to avoid breathing, even for a short time, air mixed with much gas containing carbonic oxide. Dr. Haldane furnishes a ready means of obtaining a warning of danger arising from this source, when it is necessary to enter air which may have been poisoned by carbonic oxide. He suggests carrying a mouse in an open wire cage. The mouse is rendered prostrate and helpless by breathing air containing carbonic oxide, in about one-twentieth the time required to affect a man. If, therefore, the mouse is seen to be affected, warning is given in time to beat a retreat.

Hydrogen Flame-Cap Test for Combustible Gas.

Since coal gas or gaseous fuel is poisonous, and may be explosive when it is mingled with air, it is well to be able to detect its presence in air by an infallible test, and to measure, if necessary, the proportion which is present. If coal gas is smelt, no certain knowledge of the proportion present can be formed. Most of the heating gases, apparently including coal gas under certain conditions, are free from smell. These could not even be detected, far less measured, by the senses.

Accordingly, a means of detecting and measuring firedamp, which was perfected by the lecturer some years since, has been adapted to the detection and measurement of lighting or heating gas in the air. This method is intended to take the place of certain tests depending upon physical and electrical principles. The physical methods depend on diffusion and on sound. They are untrustworthy, because their indications are disturbed, and even destroyed or reversed, by the presence of non-combustible

carbonic acid, and by changes of pressure and of temperature in the air. The electrical methods are complicated, and are not usually applicable on the spot.

The flame-cap test has been made by various kinds of test flames. It is quickly and easily carried out on the spot where the test is required to be made; and, in its best form, it is delicate and trustworthy. The flames used for the purpose have been at various times those of a common candle, a small oil-lamp, and an alcohol lamp. Lately the lecturer has rendered possible the use of a hydrogen flame; and the test thus carried out is of admirable delicacy and accuracy. The flame-cap test detects and measures proportions of combustible gas in the air which are too small to be detectable by kindling when a flame is applied.

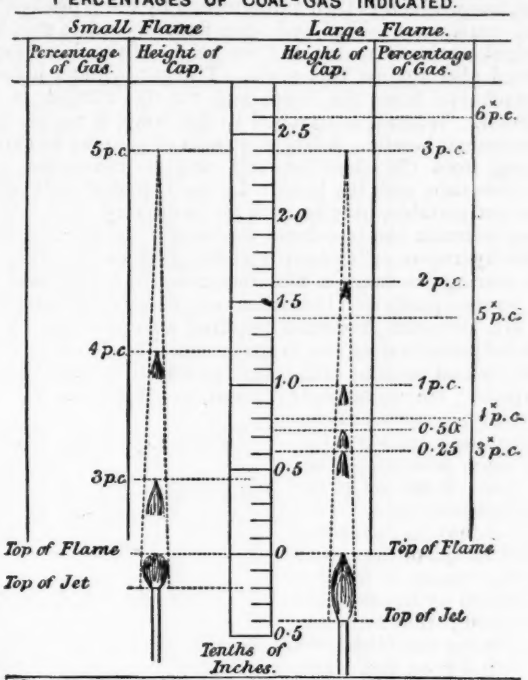
When a flame is introduced into air which contains a proportion of combustible gas below the lower explosive limit, the gas burns as a pale halo or "flame-cap" above the flame. The burning of the cap is maintained by the heat of the flame. This flame-cap is so pale that it is only seen in almost complete darkness. Hence it is not visible if the flame itself is bright and luminous; and it is not visible in daylight. The hydrogen flame presents the advantage over all other test-flames that it gives no light, and does not interfere with the perception of the flame-cap. It is also very hot, and therefore produces larger flame-caps than any other flame; and it possesses great power of resisting extinction by carbonic acid and by air movements. It is, further, easily adjustable with precision to a set or standard height. This adjustment is of the greatest importance, because the flame-cap height is constant for the same proportion of gas if the test-flame is always of precisely the same size. The cap-height varies, however, with the varying height of the flame, and to a far greater extent than the flame itself does.

With a test-flame which is always set to an invariable height, it is therefore possible, not only to test for the presence of combustible gas, but also to ascertain the percentage of inflammable gas which is present, by simply measuring the height of the flame-cap. Further, since the height of the flame-cap steadily rises as the proportion of gas in the air increases, it is possible to supply a scale which gives for each height of the flame-cap the corresponding percentage of gas present in the air, as is shown in the following table:—

Percentage of Coal Gas in Air.	Corresponding Height of Cap in Inches.	
	With Large Hydrogen Flame.	With Small Hydrogen Flame.
0·25	0·63	..
0·50	0·74	..
1·00	1·00	..
2·00	1·62	..
3·00	2·40	0·46
4·00	..	1·20
5·00	..	2·40

The flame-cap makes its appearance over the hydrogen flame when 0·1 of 1 per cent., or 1-1000th of inflammable gas is present in the air; and therefore the test is a very delicate one. The cap is seen, and its height may be measured, until the proportion of gas in the air reaches

STANDARD HYDROGEN FLAMES AND CAPS, WITH PERCENTAGES OF COAL-GAS INDICATED.



Percentages of Coal-Gas indicated by flame-cap heights over the reduced oil-flame

5 per cent.—that is, until an explosive mixture is reached. An explosive mixture at once extinguishes the hydrogen test-flame; and the presence of an explosive mixture is also detected by the fact that it kindles and burns. Hence the standard hydrogen flame at once indicates whether a mixture is explosive; and if the mixture is not explosive, it detects the presence of the combustible gas down to 1-1000th of the mixture. It further detects and measures any percentages of gas between 0·1 and 5.

Apparatus for the Application of the Hydrogen Flame-Cap Test.

The difficulty of supplying hydrogen gas for this test has been overcome by employing the gas compressed in steel cylinders, from which it is allowed to escape by means of an easily adjustable valve. In the early application of the test, the hydrogen flame was always burnt within a miner's safety-lamp. The lamp could be introduced into an atmosphere which had to be tested for inflammable gas, without incurring any risk of firing or exploding any gas which might be present.

The testing-lamp, in its most portable form, has a small light pocket-cylinder attached to it. The supply of compressed hydrogen gas contained in this cylinder can maintain the standard hydrogen flame in the lamp burning continuously for more than two hours. The hydrogen passes from the cylinder through a copper tube traversing the

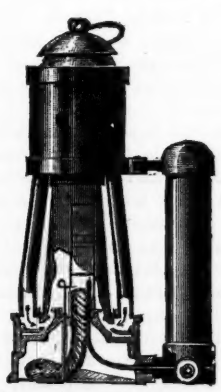


Fig. 1.—The Hydrogen Safety Lamp.

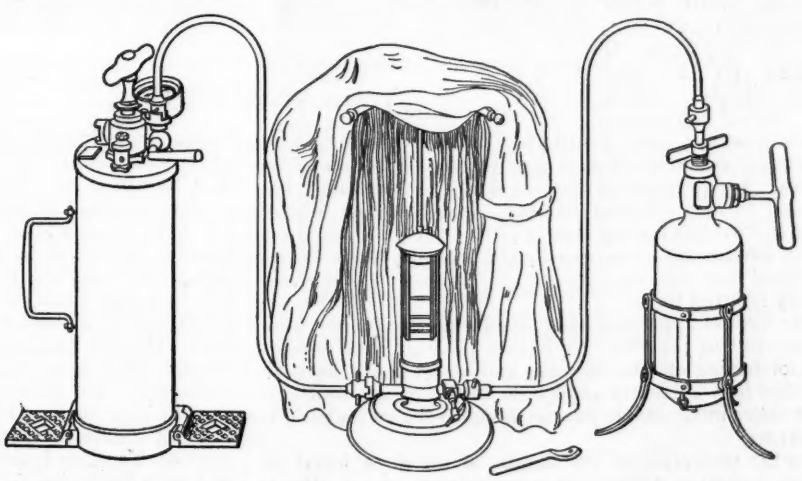


Fig. 2.—The Redwood Gas-Testing Apparatus.

oil-vessel of the lamp; and it is kindled by the oil-flame of the lamp, which is then extinguished by the "pricker," in the usual way. The hydrogen flame is set to standard height against a scale; and the height of the flame-cap is noted also against this scale. The gas-cylinder is easily detachable from the lamp, and can be carried in the pocket. When it is attached to the lamp, it serves as a convenient handle. A larger cylinder of gas may be carried slung from the shoulder, and may be connected by a flexible tube with the lamp. Larger cylinders still, which are not portable, may be used for stationary tests. They can maintain the test-flame for several weeks at a time. The hydrogen safety-lamp was designed for detecting and measuring fire-damp in the atmosphere of coal mines; but it serves equally well to test for and measure coal gas in air.

Mr. Boverton Redwood required an apparatus to test air for petroleum vapour in spaces which could not be safely entered, on account of the effect produced by breathing the vapour. He accordingly devised, in conjunction with the lecturer, an apparatus for collecting a sample of the air under pressure. This is seen on the left of the illustration, fig. 2. This vessel may be connected with an apparatus shown in the centre, in which a standard hydrogen flame is burnt; the hydrogen gas being supplied from a cylinder on the right. By this means, a sample of air may be collected from any desired space, and may then be tested by means of the hydrogen flame for petroleum vapour. The amount of such vapour which is present in the air can also be measured by the height of the flame-cap.

The hydrogen-flame testing apparatus has recently been made in a very convenient and portable form. [See fig. 3.] The collecting vessel is dispensed with; and the air is pumped direct from the space to be tested, over the test-flame, by means of a valved india-rubber ball, connected by a rubber tube below to the air-space, and by a rubber tube above to the hydrogen-flame apparatus. In order to make the apparatus more portable, the small pocket hydrogen cylinder is used, and the apparatus is mounted on a light camera tripod stand. The testing apparatus and the head are covered with a black cloth while the cap is being observed, precisely as is done in using a photographic camera. By a simple device, the standard flame may be adjusted to two different heights; and thus the whole range of coal-gas testing from 0·25 to 5 per cent. may be rapidly carried out—the cap height measurements being converted into percentages of gas by reference to the scale already referred to.

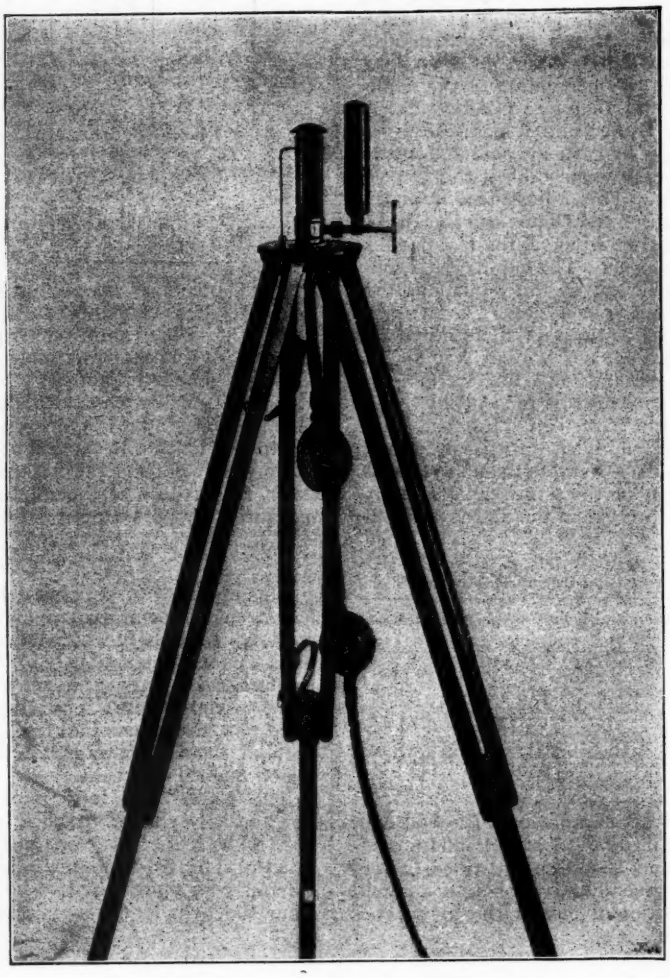


Fig. 3.—The Clowes-Redwood Portable Testing Apparatus.

[Total Weight, 11 Lbs.]

This form of apparatus has proved most convenient and trustworthy in practice. It has at present been mainly used for testing electric culverts and street-boxes for coal gas; but it is evidently applicable to testing for coal gas or for other inflammable gas or vapour in the air under any conditions.

For the perfecting of the details of all these forms of testing apparatus, acknowledgment is due to Messrs. W. J. Fraser and Co., of 98, Commercial Street East, London, who are the sole makers and licensees of the apparatus in this country. Further details of the forms of testing apparatus are obtainable from Messrs. Fraser, or from their agents, the Gas Lighting Improvement Company, 18, Devonshire Street, E.C.

A full and detailed description of these different forms of testing apparatus, with illustrations, will shortly appear in the lecturer's book on "The Detection and Measurement of Inflammable Gas and Vapour in the Air," which is nearly ready for issue by Messrs. Crosby Lockwood and Son, who have courteously allowed the use of the block of the scale showing standard hydrogen flames and caps, with the percentages of coal gas indicated.

The President said they had all listened with great interest to the lecture, and he had no doubt the gas industry would derive considerable advantage from the use of the ingenious apparatus that Professor Clowes had devised.

Mr. J. Stelfox (Belfast) proposed a hearty vote of thanks to Professor Clowes for the very able and lucid manner in which he had brought before the meeting a most interesting and important subject. Even if his position admitted of his introducing any debateable matter, motives of principle would make him hesitate to do so; but he might say they did not believe them to be guilty of quite so much iniquity in having carburetted water gas as appeared by the proportion of carbonic oxide shown in the table. That, however, was a matter which would vary with the amount of oil used. So much had been said as to the danger of water gas, that they looked very seriously on anything in the nature of what they called "gassing." Formerly, if a man inhaled coal gas, they used to give him a bottle of porter or soda water, and lay him on his back. Sometimes he was sick; but they never apprehended any danger. More recently, as an additional precaution, they had provided an oxygen-bottle; but it had only been used once. They had had three cases where men had inhaled water gas, in two of which it arose entirely from want of due caution; and one only was serious, and had to be treated medically. In one case, a man working on the top of a scrubber got himself twice "gassed;" but he went in the third time, after he had revived somewhat on the outer balustrade. He was able to walk down the spiral steps 65 feet to the ground, and then succumbed. The second case was that of a fitter who went to drill a hole in a pipe through which carburetted water gas was passing, and allowed the issuing gas to strike full in his face. He also took a good dose. But there was nothing serious; and, after walking him about a little while, he recovered. The third case, which happened quite recently, was the only one in which no blame attached to the man. A slight leak developed in a purifier, where this man was working for some hours. He made no complaint, except of a little headache, all the morning; but about an hour and a quarter after dinner, he began to feel giddy and

faint. He had, perhaps, a little physical weakness, which laid him open to the influence of the gas. It was now suggested that, in addition to an oxygen-bottle, a small colony of mice should be kept on hand. But it occurred to him that something might depend on constitution; and he should hardly like to depend too much on the mouse. Possibly, if it were a delicate man and an able-bodied mouse, the former might suffer more than the latter. He was sure they would all agree in according to Professor Clowes a cordial vote of thanks.

Mr. C. Stafford Ellery (Bath) seconded the motion, and desired to thank Professor Clowes especially for the very complete way in which he had illustrated his lecture by experiments. He hoped that, useful as the apparatus he had shown might be, none of them would have frequent occasion to use it.

The motion having been carried unanimously,

Professor Clowes, in reply, said a large portion of the thanks was due to Mr. Davenport, who had so ably assisted him in the experiments. He thought Mr. Stelfox had slightly mistaken what he had said about water gas. The analysis he had shown was that of American carburetted water gas, not coal gas enriched with water gas.

Mr. Stelfox said they made water gas from coke, with from 28 to 32 per cent. of carbonic oxide.

Professor Clowes said the figures he had given were American, and were, he believed, generally accepted. Of course, if the water gas were at all impure, the proportion both of hydrogen and carbonic oxide, would fall in proportion. He did not think there was any danger to be apprehended from a mouse having a healthier constitution than a man; but there was another point upon which he at first had some qualms, and that was the Anti-Vivisection Act, under which any experiments on live animals were forbidden except to persons holding a licence. It was pointed out, however, by Dr. Haldane, that the mouse suffered no pain during the proceedings; and therefore the Act did not apply.

PAPERS AND DISCUSSIONS.

NEW DETAILS IN GASHOLDER CONSTRUCTION.

By E. Lloyd Pease, of Stockton.

As implied by the title, this paper has for its object the gathering together, in a short description, of some of the details met with in the construction of recent holders. Perhaps it is hardly necessary, under the circumstances, to clear the way by saying that the new details refer solely to those to be found in rope-guided holders; but, in order that the details may have the importance that their position gives them, it must be added that the holders themselves are to be met with on the works of very prominent members of the Institute. It is a matter for gratification to be able to allude in this paper to the carrying out of considerable works in which many new features are to be found; seeing that any departure from recognized practical engineering must be attended with considerable additional responsibility on the part of those who are prepared to make the departure.

The fact that the storage of a gas-works may be increased by the addition of new lifts to old gasholders, or by building new gasholders—the latter having only one or a considerable number of lifts—makes the various details consequent on the application of the rope system to different requirements, somewhat numerous. This number is added to by the circumstance that the ropes, as described later, may be arranged in single, double, or higher purchase.

It is proposed to allude to four typical cases of gasholders constructed or enlarged on lines varying according to the circumstances existing in each instance. Of the four cases, only one is that of an entirely new holder. The three others, in varying degrees, are examples of additions to existing holders—viz., by the alteration of a single into a three-lift holder, the columns being removed and the holder worked entirely on ropes; by the addition of two lifts to an existing two-lift holder, the columns remaining practically without alteration; and by the addition of two lifts to a two-lift holder, the columns being increased by the height of one lift, and the inner lift rising above the columns and working on the rope system. The cases in which holders have been altered on the lines last mentioned —*i.e.*, by the application of the rope system to one lift rising above the columns—are somewhat numerous; but the instance more particularly referred to here is that of the four holders at Nottingham, the capacity of which has been practically doubled by Mr. Chester in this manner. The following are the approximate dimensions of the above holders: Mr. David Terrace's three-lift 180 feet holder, without columns, at Middlesbrough. Mr. Tully's three-lift 50 feet holder, without columns, at Sligo. Mr. T. O. Paterson's four-lift 160 feet holder, at Birkenhead; the two inner lifts rising out of the columns. Mr. W. R. Chester's additions of two lifts to each of four two-lift holders, at Nottingham.

The Nottingham holders have played an important part in the introduction of this system of gasholder extension. At the same time, it is open to question, especially in view of recent experience, whether this hybrid method of enlargement takes full advantage of the usefulness of the rope system as a means of securing stability when two lifts are added.

It will, perhaps, be interesting very shortly to examine the support supplied to the inner lift of the 120 feet holder at Nottingham, and the approximate strain that may be brought to bear on the ropes; and also the weight of the carriages in the alternative scheme that might have been adopted. The number of ropes employed on the top lift is eight; and taking the wind pressure on half the exposed side of the lift at 30 lbs. per foot (which is probably much in excess of the possible amount, as will be further suggested later), the strain exerted, if all were taken up by one rope, at the extreme diametrical distance would not exceed 2·2 tons, whereas this amount would have to be increased to 22 tons to break the rope. It is therefore clear that eight ropes are not required, and that four would be sufficient to meet all contingencies.

The design employed in the construction of the box-pulleys in the cup round which the rope passes, is shown in fig. 1; and it is obvious, from the manner in which

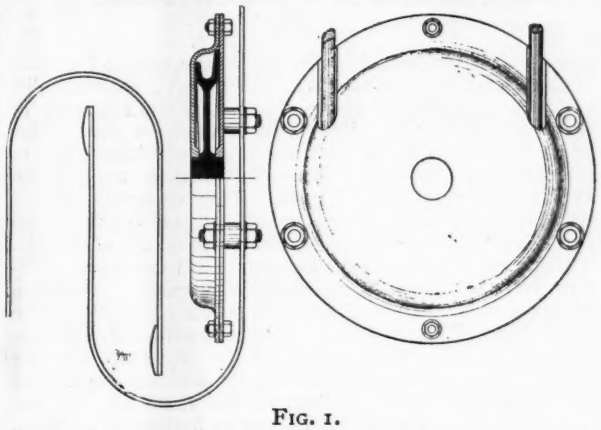


Fig. 1.

the pulley is confined, that it is an impossibility for the rope to leave the groove. In the case of all the rope-guiding pulleys, the grooves are particularly deep. As a matter of fact, there is no more necessity to provide extra ropes in case one or more should get out of order, than there is to erect an excessive number of columns for a similar reason. In either case occasional inspection is all that is required. The tendency to take excessive precaution is not, under the circumstances, surprising. It, however, causes the means adopted to compare less favourably than they otherwise would with other methods. If the new added lift were not fitted in this manner, it might be supplied with carriages on the top curb. These, when the holder is fully inflated, are neither ornamental nor useful, whatever they may be at other times. To carry out this design on the holder in question, 4 tons 16 cwt. of carriages would have had to have been supplied. These, twelve in number, would have reached out from the side of the holder a distance of 5 feet, like so many iron gibbets; and the fact that the people of Nottingham are not called upon to have in their midst four lofty structures similarly decorated, is a matter for thankfulness which, it is to be regretted, will never be appreciated at its full value.

The gasholder at Birkenhead already referred to, is 160 feet in diameter, of four lifts, each 30 feet deep. Two lifts remain within the original columns, and two rise above. Unlike those noticed at Nottingham, which are typical of several others, this holder is unique. The adoption of this design was a wide departure from previous practice; and it is highly satisfactory that Mr. Paterson's enterprise has met with perfect success. The fact that the existing columns are sufficiently substantial to meet any added strain brought to bear upon them by the increased size of the holder, is not the only point requiring attention in additions of this description. It is obviously not sufficient to be satisfied of the ample strength of the columns, and simply insert two inner lifts, in order to safely convert a two-lift gasholder into one of four lifts. From a casual observation of the two lifts rising without support from the columns, it might be inferred that there must be considerable danger that the third lift would not always work in a level position, with so much "top hamper," to use a nautical expression. This observation would doubtless have been proved true in practice, were not due precautions taken.

Diagram No. 2 annexed gives the holder in outline; and a brief consideration of it shows the tendency there must be for the third lift to get out of level under the

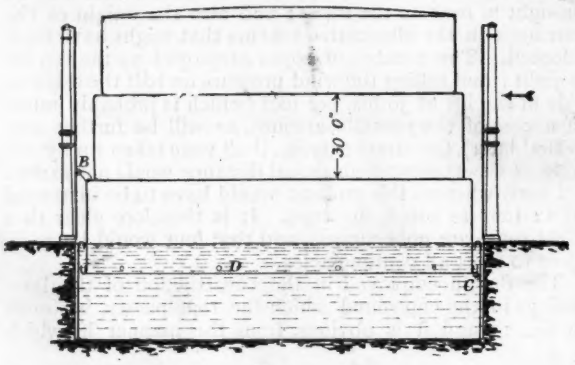


FIG. 2.

pressure of the wind. A 30 lb. gale is assumed to be equal to 62 tons on the two inner lifts acting at A; the fourth lift not having cupped on to the third lift. The tendency of the wind on the three inner lifts is to drive the holder against the lee columns, with a pressure of 78 tons, and at the same time to reduce the roller pressure against the guides on the windward side. This naturally has a tendency, especially when the holder is being inflated, to cause it to dip on the lee side, and to rise on the other side. This may take place to such an extent as to cause an overflow of water, and consequent uncupping. Although irregular movement is met by the lateral resistance of the fourth lift at C, the strains may be so great as to overcome the only comparative rigidity of the structure. If the resistance at B and C, as denoting the points of support on the upper and lower portions of the third lift, are not absolutely rigid, the lift must leave its horizontal position. In the present instance, the pressure brought on these points is so great that, without any doubt, the third lift would not work safely if left to rely solely on the support supplied by the carriages alone. The 62 tons of wind pressure on the two inner lifts act at a leverage of 30 feet above the point of support of the columns; and this in turn is only effective because of the resistance of the outer lift at C. Since this point is 30 feet below the point B, the outer lift would be called upon to resist the very considerable pressure of 62 tons. It is perfectly clear that, before the pressure could be sustained, the dip at B and the cup at C—not to mention the guides on the outer lift in contact with C—would spring, and fail to give the necessary support to the third lift.

The parallelism of the third lift at Birkenhead does not rest solely on the support indirectly supplied by its position between parallel and vertical guides and its own indifferent rigidity. It is a very easy matter to continue the ropes responsible for the level working of the two inner lifts, and cause them to render assistance to the third lift. There are twelve ropes thus arranged. Both ends of each rope are attached to the dip of the outer lift; and each in its passage passes under a pulley in the cup of the third lift. By this means, this point receives the best possible support —that is, a vertical support—to meet the force of the wind exerted in a precisely opposite vertical direction. In other words, a heavy gale, which at this point creates a downward and vertical force of 14½ tons, is met by the resistance of the rope (one of twelve), itself equal to a resistance of at least 26 tons. It will be seen that the three inner lifts receive support from two sources when they are coupled together, that the support derived from the ropes is direct, and that supplied by the columns dependent on the strength, rigidity, and accurate working of the third lift within the fourth. These are the essential features of this departure in gasholder enlargement.

It is not in all cases possible to rely on the strength of the existing columns for support of a holder, when its capacity has to be doubled. It is not every holder that is so well supplied in this respect as that at Birkenhead. There are no doubt many which, in varying degrees, would raise serious misgivings, if the existing supports were called upon in this manner to do more than double duty. It has to be remembered, in adding two lifts to a two-lift gasholder, that, while the area is doubled, the height is increased in the same proportion; with the result that the strain to be met is practically quadrupled. This brings up two issues: Either it is safe to add the lifts, in which case the columns were originally much stronger than necessary; or it is dangerous to quadruple their work, if rightly proportioned to present requirements.

In the present position of knowledge, there must be many cases in which it would be difficult to come to a decided opinion. In some cases, the problem is complicated by the question as to how far the addition of extra girders and diagonal bracing will add strength to the original design. In a large holder, the angle formed by three adjacent columns is so large that it would seem that the girders and bracing connecting the middle column with the other two, must be of questionable value, owing to the flatness of the angle. If, therefore, the strain to be met is seriously greater, can this means of obtaining increased strength be relied upon? To add to the height of the columns is obviously an expedient that is worse than useless, since it increases the strain on the existing column shafts, and is unnecessary, seeing that it has been abundantly proved that the cylindrical body of the holder is sufficiently strong to be able to dispense with support aloft, and that therefore an increased height of columns is not required for the support of the higher portion of the holder. In a case where there is a doubt as to the strength of the column support, it is always practicable to use rope support in conjunction with the columns.

If there are as many as five lifts in the holder, it would be probably best to connect the two outer lifts to the ground with a separate series of ropes, in a manner resembling that employed on the outer lifts of the Middlesbrough gasholder. The question of dividing the work between the two systems must not be overlooked; for it is obvious that the object of the application of the ropes will hardly have been attained if they only come into operation after one or more columns have been cracked through excessive strain. As a matter of precaution, it is easy to so adjust the carriages working against the column guides that, under normal conditions, they will bear somewhat lightly; and without movement no serious increase in pressure can take place. Although this may be done, it is not a matter of great importance; seeing that in most instances, owing to the proportions of the holder, the ropes are in a better position to take the weight of the wind than are the columns. In the case of Birkenhead, for example, while the columns give cantilever support at 60 feet from the surface of the water, the ropes act at practically 80 feet from the centre, and would therefore have an advantage in leverage in the proportion of 4 to 3. For this reason, any slight movement is more pronounced at the point of application of the rope system than at the point of resistance of the columns, and therefore more readily checked.

If rope rigging of sufficient strength to meet all strains is applied to the holder—as in many cases could be easily done, with little or no additional expense—it is a matter of questionable utility to keep the columns and the girders in position. Possibly it will not be long before the course is more generally adopted of disposing of them for what they are worth as old metal, and, in some degree, in this manner meet the expense of enlarging the holder.

This brings under notice the third of the holders already

enumerated—viz., that of Sligo. In this case, the original 50-feet single-lift gasholder has been made into a three-lift one; and of the original structure only a portion of the crown and the outer lift remain—the columns having been removed. This was the first three-lift gasholder constructed on the rope system; and is an instance in which each individual rope traverses the whole three lifts of the holder from side to side—that is to say, there is only one set of six ropes. The holder has worked ever since the commencement with perfect regularity, and to the satisfaction of everyone concerned.

It has a rather striking appearance, inasmuch as it is somewhat higher than its diameter. The two outer lifts are provided in each case with six light channel-guides, which prevent any tendency to rotary movement on the part of the holder under the influence of a high wind. It is also interesting to mention that this is probably the first holder which has automatically registered the force of the wind against its sides. The amount of information at present to hand is not very great; but it is hoped that, in the course of time, Mr. Tully will be able to give further figures. The method carried out by Mr. Tully has been to remove from contact the carriages on the tank coping, which bear against the exterior guides on the outer lift, and at the same time to fix a pointer actuated by the compression of the spring which is fixed in connection with the bolt at the end of each rope; and this pointer automatically registers the extra compression due to the wind. These data having been obtained, it is then an easy matter to compress the spring to the same amount by known weights.

The results obtained are certainly remarkable; and, as far as they go, they render the question of the power of the wind on a gasholder one of almost greater perplexity than ever. The holder being fully inflated at the time when a westerly gale of exceptional severity was blowing over the whole country, and to a special degree on the west coast of Ireland, Mr. Tully found that the compression of the spring attachment indicated a weight of 8 cwt. This on two out of the six ropes represented the total support of the holder; it being very free in the guides at the time. It has to be remembered that each rope takes a turn round a pulley on the bottom curb; and for this reason the 8 cwt. is represented by 16 cwt. on the pulley. Taking the height of the holder, the amount of support given, and its distance from the centre line, it is possible to measure with some accuracy the weight of the wind. Taking half the area of the windward side, a wind force of only 2·6 lbs. per square foot is required to produce the result. There is no doubt but that at the time the force of the wind was equal to at least 20 to 30 lbs. per square foot on a flat surface. It therefore appears that either the wind does not exert a great force over anything like so large a portion as half of the exposed side, or that, if it does, it has a counteracting influence in the form of a back eddy against the lee side. It will be seen that, although there was a very high wind at the time, the weight of the wind against the holder was very much less than that given in the text-books on the subject.

It is somewhat remarkable that much the same figure is arrived at by Mr. Irminger, of Copenhagen, in the case of a very different holder, and in a test carried out in a very different manner. It is briefly as follows: Mr. Irminger's holder was 120 feet diameter by 24 feet deep. The holder, being otherwise free from support, was held in a heavy gale for half an hour by a single vertical rope attached to the top curb. It rolled up and down to the extent of 3 inches, and ultimately broke the rope, which was found, when tested, to have a breaking strain of 870 lbs. The result of this test, worked out on the same lines as the Sligo experiment, gives the value of the wind as something less than 3 lbs. per square foot on half the area of the exposed side of the holder. Seeing that the holder is only 24 feet high, it is hardly correct to take the centre of action of the wind at a point so near the ground as 12 feet. If this is slightly raised, the result of 3 lbs. per square foot, will still more nearly approach the 2·6 lbs. arrived at by the Sligo holder.

These two tests are very suggestive; and it is much to be hoped that, with the increased use of holders resembling that at Sligo, it will not be long before there is a much larger amount of data on which to form a decided opinion as to whether or not the figures at present given by various authorities are, or are not, much too high.

The fourth, and last, holder to be mentioned is that of Middlesbrough. The details of the gasholder at Middlesbrough may be introduced by remarking that Mr. Terrace has successfully established, on a naturally bad foundation, a holder 184 feet in diameter, with three lifts 30 feet deep, in a steel tank which is placed on the surface. The tank of the adjoining 160 feet gasholder was constructed at immense cost, owing to the treacherous nature of the ground. A comparison of the expenditure on the two holders presents a striking illustration of the varying cost at which storage can be procured. The gasholder of which the dimensions have just been given is by far the largest columnless holder in existence. This is not its only feature of interest, inasmuch as the ropes themselves are applied in a manner hitherto unadopted, and which combines several advantages by giving greater power to each separate rope.

Until the adoption of the new method, the function of the grooved wheels has merely been to change the direction of the rope, and not to secure additional power in the manner now introduced in the Middlesbrough holder. Diagrams Nos. 3 and 4 show the difference between the two. In following the traverse of the rope and effect on

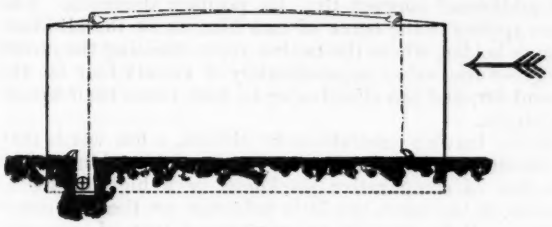


Fig. 3.

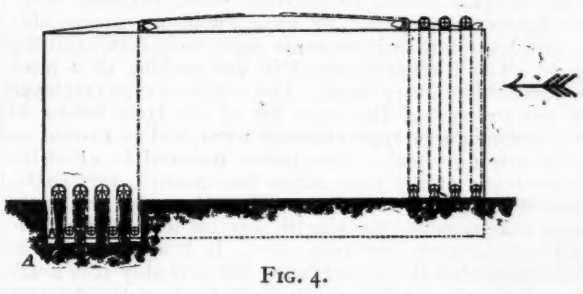


Fig. 4.

the holder, it has to be borne in mind that each rope gives support in one direction only. Referring to the diagrams, it will be seen that the ropes shown give support only if the disturbing force is exerted in the direction shown by the arrows. At least three ropes are therefore necessary. It will be seen, on referring further to diagram No. 3 (illustrating the ordinary method), that a check to irregular movement in one direction of a practically absolute character is secured, since the variation can only be to the extent of half the slack in the rope; it being clear that any slack is drawn upon at the same time by the rope on the lee and windward sides of the holder. It also follows, from the training of the rope, that no failure can take place until the weight on the pulley fixed to the bottom curb is double the breaking strain of the rope. Diagram No. 4 is a supposititious case, elaborated to show with greater clearness the differences between the two methods. This illustrates the use of a series of pulleys or sheaves, and the great power to be obtained by their use. In this case, any slack in the rope is divided by eight. The holder can only move out of the horizontal if the disturbing force is from the right to this fractional extent; and breakage of the rope can only take place when the weight at A is eight times the breaking strain of the rope employed.

It must be further pointed out, at the risk of failing to make clear a point not easy to explain by description only, that a rope has a varying effectiveness in different cases. A single rope, when trained so that its ends are attached to the tank at a quarter of the circumference apart (diagram No. 3) is effective only up to its breaking strain, since one point of its contact with the holder must be neutral if the other is fully effective. If the points of contact with the holder are separated by the diameter of the holder, both points are fully effective; and the rope may be regarded as holding down on one side and up on the other, or as able to support a weight equal to

twice its breaking strain on the pulley on the bottom curb round which it passes.

This is equally so in the case of the multiple power arrangement. In diagram No. 4, if the ropes shown passed to a neutral point, the effectiveness of each would be eight times its breaking strain. If, however, they are taken to be part of the same rope, and the points on the holder to be diametrically opposed, this effectiveness of the rope is sixteen times its breaking strain when the direction of the overturning force is such as to bring it into operation.

The question of slack in the rope, and the division of it, is only mentioned to show that the control of the ropes on a holder is brought into play instantly with the necessity for its services; the ropes allow of practically no irregular movement. Reference has been made to the compression springs, which keep a constant tension on the ropes. The term "slack" can only, in any case, be used in a comparative sense.

The chief advantage of the multiple system of roping, is that it renders it unnecessary to traverse a superabundant number of ropes over the two inner lifts of a three-lift holder, in order that the outer lift may be supplied with the additional support that its position demands. The same applies to the outer of two lifts, as in the Middlesbrough holder, where the twelve ropes crossing the crown are given the value approximately of twenty-four on the second lift, and are effective up to four times their breaking strain.

Before leaving generalities for details, a few words may be devoted to the subject of friction in working. The question of comparative slackness, or a high degree of tension, in the ropes has little influence on the amount of friction. It is possible to conceive a pair of opposing ropes strained almost to breaking point, between which the holder remains free to move with no appreciably greater friction than if the same ropes were comparatively slack. The friction involved in the working of a rope-guided holder is very small. The weight of rope employed on the support of the inner lift of the large holder at Middlesbrough is approximately 1 ton, and is carried on easily-turning wheels. The power required to effect the transference of the rope across the crown is very slight, since the rise of the holder carries up the rope, and at the same time supplies the length required to meet the give-and-take between the two sides. It is not possible to determine what this amounts to; but probably it is much less than when ordinary carriages work with any considerable pressure up the guide of the columns. Since the effect of the gale is merely to increase the pressure on the journals of the grooved wheels, the friction can only be increased to a very small extent from this cause.

Through the kindness of Mr. Terrace, two pressure diagrams are produced—one showing the irregularities of pressure given by an ordinary holder, and the other by the rope holder. Besides being generally interesting as readings of the behaviour of holders in stormy weather, they furnish a valuable commentary on the question of the friction in the working of a large rope holder. The two diagrams are far from being taken under the same conditions. Diagram No. 5 is that given by a 160-feet holder

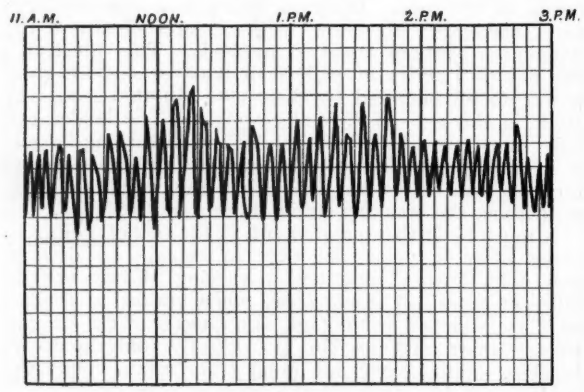


FIG. 5.

VARIATIONS IN PRESSURE BETWEEN 11 A.M. AND 3 P.M. ON SATURDAY, DEC. 22, 1894, WITH STANDARD-GUIDED GASHOLDER.

with standards; the total height of the holder, when fully inflated, being 58 feet. The diagram was, moreover, taken on the town side of the governor, and half a mile from the holder. Diagram No. 6 was taken on the inlet-pipe close to the holder, which was a three-lift one, fully inflated to a height of 120 feet above the ground-level.

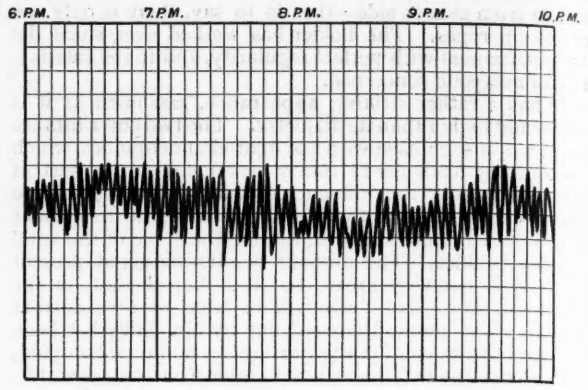


FIG. 6.

VARIATIONS IN PRESSURE BETWEEN 6 P.M. AND 10 P.M. ON SUNDAY, NOV. 10, 1895, WITH WIRE-ROPE-GUIDED GASHOLDER.

The conditions being known, the readings of the diagrams can be compared; and they in some degree at least show the behaviour of the two holders. They clearly indicate that the ordinary holder was affected by the wind to a considerable extent, while the rope holder was less affected under similar circumstances, although under much less favourable conditions. It appears from the diagrams that the extreme variation in pressure given by the smaller holder with standards amounted to $5\frac{1}{2}$-10ths of an inch of water—and this in the gas-main, after gas had passed through the governor, and the full effect produced by the holder had probably been to a great extent modified. The extreme variation given by the three-lift rope holder on the night of Nov. 10 was only $4\frac{1}{2}$-10ths, though this was a very stormy night, which compared with the reading from the ordinary holder is highly satisfactory.

It will have been noticed that these readings of the two holders do not refer to the same date. It was, however, possible on the last occasion to compare the action of the old and new holders under the same atmospheric conditions, though no pressure-register could be taken of the former. This showed that there was a decided tendency in the older holder to depress on the lee side, but that there was no perceptible movement in the large rope holder. The reason for the former may probably be found in the fact that the force of the wind raised the friction of the rollers on the lee side to a maximum, at the same time reducing that on the windward; thus offering unequal resistance to the imprisoned gas. In the rope holder, this is absent; the support or restraining influence being vertical in its action both on the lee and windward side, and correspondingly drawn upon under the action of the wind, and producing a state of equilibrium. In other words, in the case of the ordinary holder the friction of the rollers grinding up the column-guides, holds that side of the gasholder down to some extent; but with the columnless holder, the rope passing round the pulley on the lowest portion of the holder holds it up.

The question then arises as to what causes the differences in pressure shown on the diagram, seeing that there was no increase or decrease of the contents—the inlet and outlet pipes being sealed. The suggested answer is that the wind, meeting the resistance of the holder, brings pressure to bear on the gas, and to a fractional extent flattens the side exposed to the wind; temporarily lessening the capacity of the holder. This causes the holder to rise vertically an inappreciable amount; bringing into play momentarily the friction caused by the movement and the consequent increase of pressure. The diagram further shows that no greater pressure, measurable by the gauge, is given by the inner lift when rising than when standing; but when the middle and outer lifts are inflated, the greater pressure given when rising, as compared with a stationary condition, is $\frac{3}{10}$ths and $\frac{4}{10}$ths of an inch of water. The

increase in the case of the second and third lifts is doubtless greatly due to the existence of a larger number of vertical guides in those lifts; whereas the inner lift has 36 carriages on the cup, travelling in a corresponding number of guides on the inside of the second lift. This lift and the outer one have 36 guides on the outside of the lift; and it is to the existence of these two series that a great proportion of the friction is to be attributed.

The fact alone, that the rope arrangement has been abundantly shown by the holders in work to be capable of securing parallel movement of the lifts of the gasholder, does not entirely dispose of the question, as there is no single formula for applying the rope system in practice. As a matter of fact, there are more variations possible in the details of the arrangements to be made in the adaptations of the system than is the case with any other means of gasholder support; but it is not proposed to enter into the many possible combinations. From the nature of the method employed, it is easy to estimate accurately the support that is provided by the ropes, and to determine the point of application and the direction of the strains induced by the support. Besides being satisfied that the ropes are strong enough to meet any possible strain, the ability of the holder to resist the wind pressure without distortion must also be considered.

The sufficiency of the ropes on the Middlesbrough holder may be referred to for a moment. The holder contains 2¼ million cubic feet of gas; and the top curb is 120 feet high from the ground-line when the holder is fully inflated. At first glance, it might appear somewhat risky to entrust so large an erection to the sole support of the wire ropes. It will, however, be seen from the following remarks, that this apprehension is not grounded on the true state of the case.

The number of ropes used in the support of the outer lift is 36—18 of which pass round pulleys fixed to the bottom curb, and 18 are similarly connected with the dip of the outer lift. Each of the 18 ropes has a breaking strain of 18 tons, and is placed in double purchase. There are also provided 24 tank-guides, and 36 guides on the outside of the outer lift, with corresponding carriages on the top of the tank. It will therefore be seen that the holder, during a portion of the rise, is securely held by both guides and ropes, but that when it approaches full inflation, the ropes alone can be relied upon. The ropes on the outer lift are arranged differently from those that control the second lift, inasmuch as, instead of extending from the extreme windward to the extreme leeward of the holder, they traverse only about a quarter of its circumference. In this way, the holder is held down on the windward side, because the rope passes to a neutral point a quarter of the circumference off, where it passes under a pulley on the bottom curb. The corresponding rope at the far, or leeward, side of the holder, after passing under and supporting the bottom curb, traverses a quarter of the circumference of the holder along the tank top; and in its turn passes round a pulley on the dip at this neutral point, and down again to the tank side, where it is fastened. In this manner, the function of one rope passing over the crown is taken up by two ropes, each passing round a portion of the circumference.

This arrangement for the control of the outer lift of the holder when fully inflated has acted in a perfectly satisfactory manner; but it is a matter for future experience to decide whether it is, or is not, the simplest arrangement for controlling a large three-lift gasholder. The two of the 36 ropes alluded to are thus able to afford support to the holder, to the extent of 72 tons—the one holding the outer lift down with a power of 36 tons on the windward side, while the other is capable of supplying the bottom curb with the same amount of support on the leeward side.

If the estimated force of the wind is taken as 30 lbs. per square foot over half the area—although, as shown by the experiments already mentioned, the area upon which a high pressure is exerted is without doubt very much less—it appears that these two ropes would each be strained to about 13 tons, or two-thirds of their breaking load. This, however, is far from being the actual state of the case, inasmuch as, owing to the number of the ropes, four ropes holding down on the windward side and four supporting on the leeward side are in almost as good a position as the two suggested. That is to say that, while the two ropes exert their power at 93 feet from the centre line of the holder, when four ropes on each side are taken into account instead of one, the mean distance from the centre line is only 6 feet less. It will therefore be seen that, approximately, the 13 tons above mentioned is divisible among the four ropes; and when it is considered that the force of the wind was probably taken at much too high a figure, it will be seen that there is a very large margin of safety in the rope support supplied to the gasholder. The important consideration of so applying the support that the holder may not be distorted thereby, has been met by affixing the pulleys which convey the rope support to the holder to the strong vertical posts which connect the bottom curb with the dip-plate; and in no case has any fitting that has to carry a strain been fixed to anything but the strongest portion of the ironwork.

It is perfectly clear that rope support of almost any strength can be supplied to meet the requirements, whatever they may be, of a holder even of the large size of that at Middlesbrough. The important consideration, therefore, only remains whether such a holder is sufficiently strong in its construction to resist the full force of the wind without injury. No attempt will be made to decide this from a mathematical point of view; and it is believed that the following general remarks will carry more conviction than a mass of figures, even if they were forthcoming. As far as practical experience is of value, it points to the fact that there need not be any apprehension on the score of strain; not the slightest indication of this has been seen in any of the many holders at work.

To refer more particularly to the gasholder at Middlesbrough, this holder is 184 feet in diameter and nearly 90 feet high, when fully inflated. It is, in fact, a vast iron cylinder, rendered rigid by the gas imprisoned at a pressure of 30 lbs. per square foot. It is obvious that distortion implies the loss of its true cylindrical form; and in order that this may take place, the pressure on the gas inside—already equal to 30 lbs. per square foot—must be increased. But besides this, the bottom and the top curb are retained almost unalterably in a circular form, owing to their position; so that any departure from the true cylindrical shape must take place after the resistance of these two influences has been overcome, or in spite of the fact of the curbs remaining a true circle. When it is remembered that the distance between these two circular portions is less than half the diameter of the holder, it is clear that distortion in the short intervening space is almost impossible. The fact that the holder is held up by the crown, which forms a lid or end (as it were) to the cylinder, causes the departure of the top curb from the circular form to be a matter almost of impossiblity—more especially since the influence of the gas on the sides of the holder is also in the direction of the formation of a true circle in an exactly opposite direction to that exerted by the iron sheeting of the crown. The restraining influence of the tank, which encircles the bottom curb, renders the conception of its elongation in any direction in the highest degree difficult. With the top and bottom of the vessel circular, immense strength is given to the whole structure.

Combined with the strength due to inflation, and the essentially circular form of the top and bottom curbs, there is the strength of the ironwork used in the construction of the cylinder to be relied on. In the outer lift, there are 18 chief vertical stays, besides 18 lesser ones. The former are composed of 12-inch flats, stiffened by four strong bulb steel angles. These are connected together at the top and to the curb at the bottom of the lift, and also down the full length, by a bay of sheets. This girder web of sheeting is strutted out by the imprisoned gas. The structure appears to be well calculated to resist a transverse strain. It may be taken that three bays thus united are in an excellent position on each side of the holder, in line, as it were, with the wind's direction, to prevent any lateral movement. Quite apart from other considerations, the iron framework of the holder, with the strong vertical posts uniting the heavy iron girders of the top and bottom curbs, and all connected together with the iron sheeting, form no bad cantilever structure; and when it is remembered that the form is circular, and inflated to a pressure of 30 lbs. per square foot, it is not easy to conceive that the heaviest gale could have any effect on a cylinder of such colossal proportions, and weighing 350 tons.

In yet another, and a final, reference to the holder at Middlesbrough, it may be pointed out that the weight of

the standards that would be employed were ropes not used would be about 200 tons. A comparison between the weight of the holder and that of the standards is instructive in connection with the present question as to whether the holder has enough structural strength of its own to resist the force of the wind. According to accepted practice, it has not sufficient strength, and needs that supplied by the guide framing. It is, however, pretty clear that the holder has not received full justice. While the Middlesbrough holder weighs 350 tons, and the proposed standards 200 tons, the former weight is employed in the construction of one central column half as high as it is wide; the latter in 18 surrounding posts, tied together by light girders and diagonal bracing. The former is carried and formed into a rigid whole by the confined gas; while the latter has to support its own weight, and in comparison is decidedly loose-jointed.

The design of standards here cited is by no means light, if compared with designs in use, and to an increasing extent adopted at the present time. Looked at in the light of this comparison of weights, the suggestion that the light iron tracery which surrounds the rigid boiler-like forms of so many gasholders is there to give assistance to the holder by preventing distortion, strikes the mind as almost absurd. If it is there merely to assist the holder in rising to its full height, and to support it when there, that is an entirely different matter, and is merely another way of doing that which can be done more cheaply by using wire ropes. Would it not be better to incorporate the weight of iron in the standards in the body of the holder, rather than distribute it in a separate erection, if the holder is not deemed sufficiently substantial?

If the question is examined for a moment more in detail, it will be seen that in either case of the holder or the standards, the wind strain is brought down to the ground through the lower portions of the respective structures. In posts so light as those frequently made, the diagonal ties are largely relied on for the transmission of the strain to the foundations. If the bottom lift is compared with the bottom tier of standards, it is seen that there is a very much greater section of iron in the side sheets between the vertical stays than in the wind ties between the standards; and whereas the sheets are always taut, the wind-ties in warm weather are very frequently somewhat loose. The cups and dips, which exist in the form of a girder connecting the vertical posts, weigh twice as much, and owing to their curved form are probably stronger for their weight, than the girders between the standards; while the vertical stays are double the number of the standards, and carry no load. This leads irresistibly to the conclusion that the outer lift of a large holder, such as that at Middlesbrough, is an immensely strong cylindrical structure, and one that, owing both to its form and the amount of iron used in its formation, compares, for rigidity, very favourably with the posts with which it is commonly surrounded.

Sufficient has, perhaps, been said to emphasize the contention that the holder has a claim to be considered a structure of great strength. Had a large and weighty gasholder feelings, it might justly be aggrieved that its reputation rested solely on the "whipper-snapper" posts surrounding it, and that its structural weakness was deemed to be such that collapse would inevitably result without their support. The Great Pyramid would doubtless have the same sentiments did it find that it had been considered advisable to set up a row of date palms round it, to break some of the force of the wind. The aim of this paper will have been achieved if, without dogmatizing on the subject of rope gasholders, it is found to include details and theories of any interest regarding them.

Discussion.

Mr. D. Terrace (Middlesbrough), said, as he had put up one of the largest holders of the construction referred to, he might be expected to say a few words on the paper. So far as the holder was concerned, it had not given the slightest cause for anxiety; and it answered all the tests most satisfactorily, even in a very high wind. The tank, however, since it was filled with water, had been settling at the rate of about ¼ inch per week. But provision was made for this by having the inlet and the outlet pipes articulated. The settling had been anticipated, because, in making the exploration holes before putting in the concrete foundation, they found they were first on a 5-feet bed of hard clay, and then running sand. It was therefore only to be expected that the holder itself would sink, especially with a weight of 30,000 tons, or equal to 30 cwt. per square foot of surface. It was still sinking slightly, but it would probably come to a standstill as soon as the water in the "sponge" had been pressed from it. With regard to the force of the wind, he could not altogether agree with Mr. Pease in the assumption that the fluctuations in pressure were due to simple force. He thought they were due to gusts, causing jerks in the pressure, rather than to absolute pressure on the side of the holder containing gas. With respect to the cost, so far as he knew, this holder had been the cheapest in construction it was possible to conceive. The concrete foundations only cost about £1 15s. per 1000 cubic feet held. The steel tank itself cost about £3 10s. per 1000 feet; and the holder, £3 10s. So that the entire 2¼ million holder, including tank and everything, was constructed for £7 per 1000 cubic feet. He need only add that they had every confidence in the holder working satisfactorily. Naturally, to begin with, they had some hesitation, being a new thing; but having had experience of it now, they were entirely satisfied.

Mr. W. H. Y. Webber said that all who had followed the reading of this most striking paper must agree that the author had laid the whole gas industry under very great obligations to him by his ingenuity and perseverance. It was one thing to bring out a promising or clever-looking scheme, and quite another to stick to it, and year by year to apply it in practice, and demonstrate its efficiency in the way Mr. Pease had done. The paper showed really the progress which the wire-rope system of guiding gasholders had made in that gentleman's hands; and it proved how thoroughly capable he was to work out the system in a way which would give satisfaction to all who might take his advice in connection with this matter. It was impossible for anyone, even with the paper in his hand, to follow Mr. Pease through the detailed investigation of the precise operations of the various ropes, of which he was such a complete master. There used to be a striking exhibition in which a conjuror, being very carefully lashed with ropes in all sorts of ways, and apparently most securely tied up, managed to slip out in a remarkably short space of time. But Mr. Pease had shown how he could do exactly the reverse. He could apply a few ropes to a gasholder in such a manner that it could not, by any possibility, get out of guiding, even under the compulsion of the strongest wind that could blow. The paper confirmed him (Mr. Webber) in an idea which he had entertained for many years, and which he turned over a good deal in his mind before introducing this subject to the Institute in 1887—namely, that up to the present time they had only the very vaguest idea of the work the guide-framing of a gasholder really had to perform. He was not at all surprised to hear that the particular tests applied at Sligo showed that the pressure of wind on the gasholder, as far as could be seen, amounted to very little, for he had long been convinced that if a gasholder could be made to hold itself up against its own top-heavy nature, it did not matter what the wind could do to it. If they had a gasholder, on the wire-rope or any other system, which could be safely inflated at any time during the calmest weather, they could sleep perfectly contented during the heaviest gales—provided, of course, that nothing gave way. The remark that the time had come when the utility of the fixed vertical guide-standards of gasholders must be reconsidered, was one he fully agreed with. The paper marked another stage in the development of this most interesting and important subject; and probably henceforward they would see gasholder framing gradually dwindling, until eventually he had not the slightest doubt that those who were alive twenty years hence, and took an interest in such matters, would find there were hardly any fixed gasholder standards in existence. If they did no good, what was the use of keeping them? Why should they encumber the ground? If one knew how much strength he ought to put in the guide-framing of a gasholder, he might tie it up or prop it up; but it was impossible always to satisfy oneself that a mere prop was acting as it should do. It might act to-day and not to-morrow. With rope gearing, however, they could always satisfy themselves that it was holding properly. When the paper came to be studied, they would see more and more the force of the argument that the light iron guide-tracery to which they were accustomed really partook of the

nature of a structural joke; and when the author asked whether it would not be better to put the weight of iron now used in the standards into the body of the holder, rather than distribute it in another direction, he (Mr. Webber) said emphatically "Yes." The top curb and the top of the holder were very strong. The bottom curb of the holder was its weakest point; and in order to make holders perfectly secure on any system, it was necessary above all things to make proper use of the lower curb. It must be in the form of a strong girder; and the weight should be put there rather than into the standard uprights and tie-bars, which one could see flapping about in the least wind. The strength should be in the bottom curb and the vertical posts, and also in the cups and grips of the lower portion, and in the sheets, because decay was the greatest enemy of gasholders. Far more accidents happened through gasholder framings being blown down before the holder was inflated than afterwards. As a matter of fact, it was the gasholder which held up the framing. There was a case of a most unfortunate collapse of this kind in one of the gasholders belonging to the East River Company in New York. If he remembered rightly, the framing was nearly finished, and before the holder was ready to be inflated, the whole thing was blown down; and it was to the great regret of the constructors that the holder was not up, and able to keep the framing in its position. He congratulated Mr. Pease on the forcible way in which he had put his argument; and as far as his (Mr. Webber's) individual opinion was worth anything, it was distinctly upon the author's side. He agreed with him entirely that the day of fixed guide-framing was now past. Even as it was, the outer lift of a large holder was an immensely strong cylindrical structure; and with a little addition to it—amounting to nothing like the weight of material saved by the abolition of the guide-framing—when systematically applied in the form of ropes, it was perfectly secure. He looked forward to an altogether new era in gasholder design and construction.

Mr. E. H. Millard (Durham) said anyone who had given consideration to the wire-rope system of guiding gasholders would be perfectly satisfied as to the reliability of the structure. The real point was the decay of the holder. The only possibility of weakness, however, would be in the wear of the ropes at the water-line, where they were exposed to atmospheric influences—the nature of the ropes themselves exposing them also, to some extent, to deterioration by oxidation. He hoped Mr. Pease would make some remarks on this point, because he believed that trouble was already anticipated with regard to it.

Mr. W. D. Child (Romford) asked whether placing the guide pulleys and ropes between the several lifts would necessitate any reduction in the diameter of the lifts; thereby decreasing the storage capacity of the holder beyond what would be the case in the ordinary construction with standards and carriages. Mr. Pease had explained the alteration in pressure to be due to a flattening of the sides of the holder of a weak construction—compressing the gas, and thereby raising the pressure inside the holder. But he (Mr. Child) had noticed on the diagrams that there was as much reduction as increase of pressure. He should like to have some explanation as to why the pressure was reduced below the normal as well as increased by the alteration in the shape of the structure.

Mr. Isaac Carr (Widnes) said he had listened to the paper with a great deal of interest. When the subject of dispensing with guide-framing was introduced some ten years ago, it met with some adverse criticism; and questions as to the stability of the structure were frequently raised. But, so far as the discussion had gone, not one word had been said in regard to the stability of columnless gasholders. To his mind, it indicated a great amount of progress when gas engineers could so soon assimilate the notion of doing away with the columns. He had erected a very large holder on this principle; and, in working out the details before accepting it, he came to the conclusion that, with a certain mechanical margin of safety, the condition of the columnless gasholder was precisely similar to that of one resting on solid ground. Of course, the mechanical margin must be sufficient to guard against any possible lateral stress that could come against it. This question of the mechanical margin was always a vexed one with engineers. As a rule, they were pretty severe on each other; and when one said he was not going to take any risk, but make pretty sure of his ground by keeping up his strength, some of his brethren were apt to stigmatize it as a margin of ignorance rather than a margin of safety. But in calculating this margin, the extraordinary effects of gales must not be overlooked. He knew, from looking over the records of the Observatory on the Mersey, that perhaps once in twenty years they had extreme local violence of wind, such as might not occur again in a whole generation. An instance of this had recently been witnessed in America, where the violence of the wind had concentrated itself in one particular spot. Happily, in this country, we were not subject to this sort of thing to the same extent. But it did happen. There was an enormous concentration of wind-power at some particular spot, which had probably never occurred there before, and never would do so again; and this was a point which engineers required to keep in mind. He could not say he agreed altogether with Mr. Webber's remark that a gasholder which was capable of being inflated at all would be self-supporting, and capable of resisting any lateral pressure that might come against it. The great point in the safety of all these structures was the fact of every stress being brought to the base. With a column gasholder, when inflated, the stresses came on the top of the columns, 60 or 70 feet high; and when one calculated the enormous leverage of overturning power put on the top of the framework, one could readily understand its extreme weakness, and how different it was where the forces in the columnless holder were all brought down to the base. There was no question in his mind—and experience was now proving it everywhere—that the columnless holder was a great deal stronger than one with external framing.

Alderman Miles (Bolton) said he was not going to attempt to argue this question with Mr. Pease; but he did urge that something should be done to make gasholders a little less hideous and rather more "eyeable" than they were at present.

Mr. G. Pettigrew (Gateshead) said that he adopted the columnless gasholder some years ago, and he had found it work most satisfactorily. He would only ask Mr. Pease to explain how it was likely to be affected by snow and frost. He found, especially in times of snow, the holder had to be carefully watched. Of course, this was the same with a holder on the ordinary system; but it was a point worth careful consideration. The ropes coming out of the water wet were met with the frost; and he should be glad to know if there were any means by which this difficulty could be dealt with. He had been consulted by one gentleman who intended to put up a new gasholder to increase his present storage; and he (Mr. Pettigrew) advised him to adopt the columnless system because, having watched it, he found it worked much more satisfactorily than the old one. His holder had two lifts; and he was much more satisfied with its action in the wind than one constructed on the old plan.

Mr. H. Tobey (Malton) asked if it would not be possible to dispense altogether with ropes in the upper part of the holder. He said it appeared to him that if they could hold the two lower lifts firmly, the upper lifts would keep themselves up. He had a two-lift holder, of which it was only needed to guide the lower lift, and the top lift would go clean up in the air without any support at all. There was no tendency in the top lift to blow or turn over in any way, so as to uncup or let the water out. It was perfectly firm and steady, and never stirred even in the heaviest gale. It appeared to him that, if they held the bottom curb firmly, they would at the same time keep any upper lift in a vertical position.

Mr. G. Anderson (London) said he had not unfortunately heard the whole of the paper, and hardly liked to say anything which would disturb the unanimity of opinion which had been expressed. He wished Mr. Pease every success, and hoped he might make a great many of these gasholders, to his own advantage and that of those who employed him. But for his (Mr. Anderson's) own part, he should wait a little longer before adopting them. Some of the statements which had been made against guide-framing he did not think were quite logical. He saw no objection to framing except the expense; and he thought this had been put rather higher than was necessary, and the weight of iron given was more than need be. The Great Central Gas-Works were built by Mr. Croll, whose assistant he was; and he designed a holder which was 103 feet in diameter and about 53 feet high. There were

twelve standards which weighed 3 tons 3 cwt. each. These had been in an exposed place for about forty years; and, as far as he knew, they were as good now as ever. So that there was a much smaller expenditure for standards than many engineers had. He never agreed with the immense standards, in the shape of pillars and columns, which were sometimes employed. He remembered, when they built the Great Central works, he went across to the Commercial works, about a mile away, where the Engineer was putting up a gasholder; and he pointed to the dimensions of one of the standards, which was then only about 4 feet high, and he was told that it weighed about 4 tons. He (Mr. Anderson) did not say anything; but he thought that this was more than the entire weight of his own standards. Alderman Miles had put in a claim for some beauty in these structures; and he (Mr. Anderson) agreed with him. If they could beautify gas-works at all, it was better than having them present the disgusting appearance that some did. The standards should be perfectly perpendicular, of course; and the rollers should be mechanically fitted so as to play against the standards. If this were done, he did not care even if a gale occurred such as that which swept over St. Louis the other day; the holder would not blow down. He would put it to the consciences of the gentlemen present whether, if a great storm were raging, they would feel as safe in going to bed with a rope-guided gasholder as with one perfectly and mechanically guided by exterior standards. Of course, each one must speak for himself. He had had a great deal to do with gasholders, and never remembered having an accident with one. He had heard of accidents in other places, and had made such inquiries as he could about them; and he always found that there was some mechanical defect in the guiding which caused the difficulty. The columns might be out of the perpendicular; and when this became aggravated by the gasholder going up, it would uncup, and away would go the gas out of the top lift. This was traceable to defects which need not occur; and it was one of the objects of the Institute to teach men that all these things should be properly constructed.

The PRESIDENT said Mr. Pease had been good enough to refer particularly to the holders put up at Nottingham five years ago on the wire-rope principle. They were at the time some of the very earliest structures of the kind erected; and he was rather criticized for the decision he came to in connection with the raising of the standards. His holders were guided up to the second lift; and, after carefully going into the matter, both experimentally and by calculation, he came to the conclusion that in their case it was better to extend the standards a further lift, and send the upper lift right up altogether, than trust to the rope guidance for the two upper lifts exclusively. He arrived at this conclusion in spite of the argument of the author of the paper and his firm, and much to their regret. But he was bound to say he was satisfied with his decision, and thought that, under similar circumstances, he should be disposed to follow the same course. One of the reasons which led him to this conclusion was the unusual condition which existed in their particular case, of the height of the holders exceeding the diameter by something like 15 feet. Their holders were 90 feet in diameter; and, when fully inflated, they stood above the water-level 105 feet. He found, from the figures given, that this was altogether out of proportion to any of the other holders erected on the principle of doing without columns altogether, or limiting the columns to not more than two lifts out of four lifts. In the case of the Middlesbrough holder, the total height was 90 feet, whereas the diameter was 184 feet. In this case, the proportion was almost reversed; so that it stood to reason that there was much greater tendency for the holder to topple over when the base was so much smaller in comparison with the height. He had a little anxiety when the holders were first erected. He remembered being at Liverpool on one occasion when chimneys were being blown down, and slates were tumbling in all directions; and he telegraphed to inquire how the four holders were behaving. However, he got a reply from the Superintendent saying that they were absolutely steady and rigid, and that there was no cause for anxiety, although the wind was blowing a tremendous gale at the time. He anticipated that there might be some weak point in connection with this system; and he found it to a certain extent. It was a tendency to corrode between wind and water. The great proportion of the rope was absolutely as perfect as when it was put into operation; but at the point between wind and water there was corrosion going on, which, as far as he could judge, would necessitate a renewal of the ropes within a year or two. At the present time, they had been in use for five years; and he should imagine that in two more years this action would have gone as far as was wise to allow it. He also feared that the ropes passing round the pulleys would result in a considerable amount of wear and tear, and necessitate careful supervision and watching, by a man specially set apart for the purpose, to see that they were all in perfect order. There was no doubt they would work quite satisfactorily as long as all the purchases were kept in order. But if a pulley stuck, there would be danger; and in a holder with absolutely no guide-framing at all, the number of pulleys was such as to largely increase the work a man would have to do in supervision. It seemed to him that the question of the capital outlay on guide-columns and framing, and the interest it would be necessary to pay on it, might be set off against the extra cost in periodical examination of the rollers and pulleys; and when one was set against the other, he did not think there would be very much advantage on either side. It was a matter of great congratulation that this original departure in gasholder building, in the case of both Mr. Pease and Mr. Gadd, should have had its birth in this country. No more original idea in connection with gas manufacture had been introduced, at any rate during his experience; and it was a matter for congratulation that they were able to number among the Associates of the Institute the gentlemen who had introduced so original and efficient a system.

Mr. PEASE, in reply, thanked Mr. Terrace for his remarks, and said he was very pleased to find that this new departure had worked so satisfactorily to that gentleman, to whom they were indebted for his enterprise in adopting the new system on so large a scale. Mr. Webber had been associated with this movement from the commencement; and his observations would be appreciated all the more on that ground. As to the holder itself standing up on end without any outside support, it was only necessary to walk across the crown of an ordinary holder in which the top carriages were rather loosely adjusted, to see how very "wobbly" it was; and it would not take much to upset its equilibrium. Something, therefore, had to be arranged to keep it upright. He rather gathered from Mr. Webber's remarks that, if he once got a holder up, it was all right, and that the posts might be taken away. The question of corrosion at the water-line had been referred to by more than one speaker; and he would endeavour to answer this matter as fully as possible. These holders had been in existence about seven years; and it was only now that any corrosion was beginning to appear. As the President had mentioned, it was just where the wind and water met in cases where the upper lifts of holders were very seldom moved, and perhaps remained cupped for months together. This was a very trying position for a rope to be in, and one in which corrosion might be expected. In fact, it attacked the sheets just the same as the ropes at that point. There were ways of meeting it; and now the question had cropped up practically, it would probably lead to the adoption of some system of wrapping at that place, which would keep the water from contact with the rope; or it might lead to the use of a stuffing-box holding grease, or some method of that sort. But, after all, it was not a very serious point, because at a slight outlay it was possible to splice in a new piece at that point. It was the work of a short time to a practical splicer. The ropes could be taken *seriatim*, and the whole operation be soon carried through. For very small holders, in which perhaps ½-inch ropes, or less, would be required, it was now proposed to use a light chain, which would serve the purpose, and would not be affected by corrosion in the same way as very small ropes were. The bulk of the ropes on the holders which had been in use the longest time in Manchester were practically in a perfectly sound condition; and, as a matter of fact, in some holders there was hardly any corrosion even at the water-line. The use of pulleys did not necessitate a larger cup except to this extent—that they did not like to put one in a 7-inch cup; but with anything above 7 inches, it could be done easily. It was always possible to make room in the cup by either

placing the dip a little out of centre or by embaying the dip just where the pulley came. It was easily done in the course of manufacture, so that the pulley-box could lie opposite the bay in the cup, or the box itself could be set back into a bay on the dip, so as practically to be flush. The suggestion he made in the paper as to the reason for the increase in pressure, was not put forward as one which was easily susceptible of proof. It was a very difficult question to determine why, if the vessel was floating freely, it should give more pressure in a wind, because there was no appearance of irregularity of movement—no tilt and no appreciable movement. The suggestion put forward was on the ground that the side sheets were inflated in the form of a diaphragm, and that the rising of the gauge was in the nature of a pulsation formed by the impact of the wind on the diaphragm form of the sheets. Whether or not this was so, he was not prepared to say positively; and he did not quite see how the increase of pressure came in. With regard to the decrease of pressure which had been mentioned, this would likewise be accounted for by the fact that, as soon as reaction from the blow came, there would be less restraint on the gas, and, to some extent, a decrease in pressure. Mr. Irminger, of Copenhagen, had carried out some experiments in which he gauged very carefully the influence of the wind in lifting the holder; and he found that it had an absolute lifting power on the crown. This might have some influence on the form of the diagrams; but the whole question was very complicated. Another point raised was as to the appearance of gasholders; but he thought this depended very much on the engineers who purchased them. With the exception of an ornamental hand-railing, he did not know what else they could do; though it might be possible to lay out the crown of a gasholder as a recreation ground, with plants and flowers, or to decorate the sides with pictures. It was simply a question of expense. As to snow and frost, they had had no experience of any difficulties in this direction, though the winter before last was extremely severe. In all telescopic holders, an anti-freezing apparatus was advisable. But the action of the ropes in rising out of the water was so extremely slow, that they did not pick up any appreciable quantity of water for the frost to act upon; and the pressure between the rope and the groove of the pulley in which it ran was so great, under all circumstances, that it was quite sufficient, he should think, to create enough heat to melt the snow or ice—at any rate, sufficient to grind it off. The ropes were all attached at one end to a compression spring, so that even if a lump of ice were carried over the groove, it would not make the slightest difference in the working of the holder. It would only put a slight extra pressure on the spring. There had now been introduced a rope which was built up with some substance which was a constant lubricator between the strands. It was of a greasy nature, to which water would not adhere under any circumstances; and it appeared to be better than galvanized for the purpose of protection. This rope had been adopted in the Middlesbrough holder, and had been successful. It also lent itself to receiving a coat of protective mixture from time to time. With regard to supporting the bottom lift of the holder only, as suggested by Mr. Tobey, his own view was that the two inner lifts ought to be guided, or they might rise irregularly. At Middlesbrough, the roping of the outer, or third, lift was a thing apart. It held the outer lift, and this lift held the others. The roping of the two inner lifts was separate from the roping of the outer lift; and its function began as soon as the two inner lifts cupped. The controlling guides, when the holder was within a foot of cupping up to the third lift, was not sufficient to keep it steady without some support. In giving the weight of the columns at Middlesbrough, he took the design which would have been accepted if the rope system had not been adopted. Of course, there could be lighter columns; but those proposed were designed in competition with other makers. There was no extra weight put in. Of course, besides the columns, girders were an important item in estimating the weight of the ironwork as well as the wind-ties and the channel-guides in which the holder worked. They all combined to make the weight of the frame vary from one-half the weight of the holder, in some cases, to almost a greater weight than the holder itself. In fact, there were cases in existence in which the columns weighed much more than the holder. Accidents traceable to defects of standards were well known; and his suggestion was that this was a reason for doing without them. If there were no standards, there would be no accident from them. Both in the cases of standards and ropes, a certain amount of inspection was always necessary; and he would suggest that the inspection of ropes was no more than was required for the oiling of the guides and wheels that ran up the columns. In all cases the lubrication of the wheels had to be attended to. It was a very simple matter to lubricate those which carried over the tops; and the others, working continually in water, lubricated themselves. With regard to the proportions of holders, as alluded to by the President, the Nottingham holders were, no doubt, peculiar. The Sligo holder, however, was rather higher than it was wide, but only slightly so. As to the stability of gasholders in a gale of wind, the American tornado had been alluded to. This brought to his mind the fact that one of these holders was in existence at Roanoke at the time a tornado passed over the town; and it stood in a perfectly satisfactory manner.

GAS-ENGINES AS ECONOMICAL MOTORS.

By J. Holliday, of Scarborough.

The tendency of the times, particularly where comparatively small motive powers are required, is to gradually displace steam and manual labour, and introduce gas, oil, hydraulic power, or electricity as the prime mover; the small power users realizing for *themselves*—as I think it stands confessed that few gas undertakings have pressed the matter upon their notice very assiduously up to the present—that, as a handy, economical, and reliable source of power, gas, where it is readily available and of reasonable price, is certainly far in advance of any of the other forms named above. Even in large factories, where the whole of the power, as a rule, is generated at one centre, and distributed by shafting, belting, or rope-drives to the various departments in which it is required, mechanics are beginning to recognize the fact that a system of small detached motors, located at the exact points at which the power is being used, is a far more sensible and economical arrangement.

In the case of the central arrangement of (say) duplicate steam-engines and a stack of boilers distributing the power to the whole of the factory, so long as the whole or the greater part of the plant is in operation, it may possibly be an advantage—and in many cases, it *is* a distinct advantage—to have the power-generating plant under one control; but when departments are working irregularly, and the load is constantly varying, or where much overtime in special departments is being worked, the advantage of separate motors is without doubt very great.

In this particular of the departmenting of large factories, compressed air, hydraulic power, and electro-motors are strong competitors with gas. But all of these systems, by their physical characteristics, are placed at a distinct disadvantage owing to the very considerable loss of potentiality in transmission. A writer in an American publication puts this aspect of the case so very succinctly, that I cannot do better than quote his words. He says:

> Those who have spent any time on the problem of the subdivision of power know that few of the systems usually recognized satisfy us generally. Mostly all of them involve heavy first cost, heavy expenditure for generating plant, transmission plant, and re-developing plant at the other end. For instance, in electrical transmission, if your total works need 1000-horse power, besides your 1000-horse power of boilers, you must follow with a 1000-horse power steam-engine and a 1000-horse power generator, your mains for carrying the electrical power, and then on the top of that a 1000-horse power of motors. That is, of course, losing sight of all small factors and percentages of loss. The present status of gas power, and also its immediate promise for the future, depends upon this statement of the problem in this part—that gas power offers the ideal solution for the subdivision and transmission of power, the mechanical difficulties being, for the time, lost sight of.
>
> In other words, let us suppose that a large industrial plant requiring (say) 1000-horse power subdivided into (say) 50 different units, which are utilized at various points, in different buildings, on different floors, at different speeds, for different hours during the day under different conditions of varying and steady load—suppose that in such a plant as that we instal a 1000-horse power gas generator, or take the equivalent gas from the supply-main, it is evident that the first cost is away below that of any system, with the possible exception of a subdivided steam plant. But there is one big advantage which a gas plant has over a steam subdivided plant in point of operation, and that is, that in the steam subdivided plant, no matter how large a proportion of the load be off, the central generating plant—*i.e.*, the boilers—must be run; and the fixed charges of running cannot be altered. Steam must be kept up, the boilers must be kept hot, the stack (if there is one) must

be kept hot, and the labour must be there to take care of the whole matter. I have myself tested one factory in which, for a large proportion of each day, the efficiency for the transmission of the power between the boiler plant and the work was 5 per cent., simply because they had to keep the whole plant going in order to move one such department.

I must ask you to pardon me for introducing so long a quotation, but it so exactly hits the points I was desirous of expressing that I ventured upon doing so.

The above is a strong argument in favour of gas, and should help to place it upon the same level of cost, even if its prime cost should in any instances happen to be somewhat greater than other sources of power. Similarly, in town supply over a large area, gas possesses manifest advantages over any other system of power distribution, on the same grounds. There is practically no loss in distributing gas through the mains, in well-managed undertakings, beyond a very small percentage of leakage; and this does not affect its potentiality in any degree, even if it does slightly affect the economy of distribution.

"There can be no doubt that, in our larger towns, at no distant date, a supply of power transmitted through a pipe or wire from central stations will be looked upon as a necessity of life, both for domestic service and for the purposes of trade," so Mr. Joseph Parry, the Water Engineer to the Liverpool Corporation, is reported to have said in an address to the Institution of Mechanical Engineers some few years ago. A table, showing the cost of working warehouse hoists by steam, gas, and compressed air, accompanies the address, from which it appears that the average cost of two estimates of each, per indicated horse power per hour, runs out as follows:—

Steam	0·810d.
Gas	0·425d.
Compressed air	0·700d.

Although the author does not state specifically upon what rate he bases his estimate for the gas consumed, I presume we may take it to be the current rate charged by the Liverpool United Gas Company, which I believe is 2s. 10d. per 1000 cubic feet; and as this is a fair average price for the country generally, the results given above are highly satisfactory from the gas engineer's point of view. Mr. Parry further mentions the fact that, although hitherto the great bulk of the loading and unloading work in the large warehouses and bonded stores on the docks has been done by steam power, gas-engines have of recent years been fixed in many of the new warehouses, and have replaced steam in many of the older ones. Compressed air, he adds, has been tried in some few instances; but it was not sufficiently successful to lead to its adoption on a large scale.

These remarks, emanating from an entirely unprejudiced source, are sufficient to give any gas manager who may have felt at any time diffident with regard to recommending or pushing forward the claims of gas-engines on the score of economy and efficiency, good heart for the future.

With regard to the use of the gas-engine for trade and commercial purposes generally, it is not too much to say that whatever, within the compass of a gas undertaking's supply-mains, power is required, the claims of gas as a prime mover can be shown to supersede those of any other competitor. For corn grinding, printing, meat chopping, coffee grinding, wood sawing, bottle washing, and last, but not by any means least, electric lighting installations, no other source of power ought to be allowed to have any chance of becoming a possible competitor.

In Scarborough, a town in which industrial pursuits are conspicuous only by their absence, we have some fifty to sixty gas-engines in use—a comparatively small number; but as I have kept a careful table of their work for the pastt welve months, it may perhaps be of interest to you if I subjoin the following particulars of their annual average consumption, &c. [See table.]

It is, of course, practically impossible to institute any fair cost-comparison with steam or other prime mover necessary to generate the individual powers or the aggregate power set forth above. But I think we may fairly conclude that it could not have been done at anything like the figure shown; and, of course, in many of the cases, steam power could not have been applied, and hydraulic, compressed air, or electro-motive power is not readily available.

It will be seen from the table that the consumption of gas per annum for motive purposes is equal to 2·5 per cent. on our total output (220 million cubic feet), and

Purpose for which the Engine is Used.	Size. Nominal Horse Power.	Number at Work.	Average Total Consumption of Gas.	Average Consumption of Gas per Engine per Annum.
			Cubic Feet.	Cubic Feet.
Bottle washing	½	3	330,700	110,233
Bread baking	½	3	71,800	23,933
Butter making	¼	1	42,900	42,900
Coffee grinding	½	1	60,200	60,200
	1	1	108,100	108,100
Corn grinding	2	3	41,700	13,900
	2½	2	108,300	54,150
	3	1	25,800	25,800
Cycle works	½	1	44,800	44,800
	2	1	21,300	21,300
Electric lighting	2½	1	45,600	45,600
	4	1	1,500	1,500
	6	1	117,000	117,000
	7	1	5,700	5,700
	8	1	193,100	193,100
	16	1	436,000	436,000
Lift (hotel)	3	1	651,300	651,300
Meat chopping	¼	1	1,500	1,500
	½	2	66,900	33,450
	1	4	404,300	101,175
Printing, &c.	½	3	124,000	41,333
	1	1	89,000	89,000
	2	4	683,800	170,950
	5	1	310,100	310,100
	6	3	762,000	254,000
Pumping	1	1	22,200	22,200
Wood sawing and turning	½	1	34,100	34,100
	1	1	53,900	53,900
	2	1	112,800	112,800
	3	1	110,400	110,400
	4	1	42,300	42,300
	6	4	421,000	105,250
	9	2	144,700	72,350
	..	55	5,688,800	..

Schedule of above Table.

Total number of engines in use	55
Total nominal horse power	154·75
Total annual consumption of gas	5,688,800 c. ft.
Average annual consumption of gas per engine	103,432 "
Average consumption of gas per horse power per annum	367·71 "
Cost per horse power per annum (gas at 2s. 9d. per 1000 cubic feet)	10·11d.

is an increase obtained over the ordinary consumption, as Mr. Colson pointed out in his Inaugural Address to the Incorporated Institution of Gas Engineers on May 9, 1894, without the outlay of any additional capital beyond the point of keeping the mains and services of sufficient capacity to prevent any complaint as to supply or inadequacy of pressure. This, although an interesting fact worthy of notice in passing, is somewhat of a digression perhaps from the strict lines of my paper.

In recommending gas-engines for use, there is an element to take into consideration, which, if overlooked, is sometimes apt to lead us into trouble—viz., the relative efficiencies of the engines themselves. I have had a typical example of this within the last few months. I was consulted by an architect as to whether it would be more economical to lay down a separate installation of electrical plant, driven by a gas-engine, for lighting some new business premises he was erecting, or to take the current from the local Electric Supply Company. Naturally, I was anxious to secure his client as a customer; and, after looking carefully into the matter, I made a report to the effect briefly that, basing my estimate on the results obtained from the best type of gas-engine, and on the price charged for the current by the local Company, it would cost something like 18 per cent. less to generate the current from a private installation. I heard incidentally some time later that the engine, dynamo, &c., were on their foundations, and it was hoped they would shortly be at work. Being in the district some days later, I felt some little curiosity to see what was being done, and accordingly looked in. The whole of the arrangements appeared neat and trim; but the engine itself was one I had never heard of before, and on examining it closely I confess I began to feel somewhat dubious as to the results. In the fulness of time, the installation was formally put to work; but, unfortunately, the engine developed a disposition—I am unable to say whether it was due to heredity or not—to kick like an unshod colt; and the discharge from the exhaust was taken by more than one wayfarer, three or four streets away, for artillery practice on the Castle Hill. It was unfortunate; but I hope we may be able to induce the gentleman who for the present possesses this eccentric mechanical toy, to consign it to its natural abode—the scrap heap—and introduce an engine with a reputation, when I have no doubt all will go "merry as a marriage bell."

I am not in a position to place before you any extended

personal observations as to the relative costs of gas, steam, and hydraulic power; but the following table, prepared by Herr C. Korte, may be taken as furnishing reliable data, and as the result of investigation undertaken by that gentleman for the purpose of fixing a tariff for the use of the municipal hydraulic mains and electric current at Barmen—a large industrial town in Rhenish Prussia, being the principal Continental seat of the ribbon manufactories.

Size of Motor . . .	. . .	¼	½	1	2	3	4
Class of Motor.	Hours Daily.	d.	d.	d.	d.	d.	d.
Gas motor (gas at 3s. 4d. per 1000 cubic feet .	5	7·92	5·76	3·72	2·88	2·52	2·40
	10	5·76	4·08	2·64	2·28	2·04	1·92
Hydraulic motor (water at 6½d. per 1000 gallons)	5	12·12	10·80	9·72	9·00	..	..
	10	..	..	..	..	..	..
Steam motor (coal at 12s. 6d. per ton) . . .	5	..	..	4·20	2·88	2·40	2·04
	10	..	..	2·88	2·04	1·68	1·44
Steam motor (coal at 20s. per ton). . . .	5	..	..	4·92	3·48	3·00	2·82
	10	..	..	3·48	2·52	2·16	1·92

From the above table, it will be seen that in the larger sizes and with regular working, and when the price of coal is not excessively high, the steam motor competes closely with the gas motor; but in the smaller sizes the gas motor is the only one to be considered, and that with gas at the relatively high price of 3s. 4d. per 1000 cubic feet.

Through the kindness of a friend, I am enabled to submit an interesting table, showing a twelvemonth's actual working results of a private electrical installation actuated by gas power.

Month.	Board of Trade Units.	Total Horse Power Developed.	Total Gas Used.	Gas Used per Horse Power.	Cost per Unit, Wages, Attendance, and Gas.
			Cubic Feet.	Cubic Feet.	d.
Jan. . .	2283·5	3091·1	93,700	30·3	1·90
Feb. . .	1777·0	2341·3	72,800	31·1	2·00
March .	1310·6	1706·0	57,700	33·8	2·60
April . .	847·0	1131·9	35,400	31·2	2·63
May . .	501·0	706·2	22,100	31·2	4·81
June . .	122·2	161·8	7,100	39·5	5·40
July . .	225·7	302·0	9,500	30·8	3·70
Aug. . .	594·2	790·3	24,100	29·6	2·28
Sept. . .	1127·4	1555·0	48,100	30·6	2·13
Oct. . .	1912·6	2577·5	75,900	29·4	1·86
Nov. . .	2365·2	3132·0	95,400	30·4	1·69
Dec. . .	2412·0	3220·3	92,100	28·5	1·53

The gas used per indicated horse power is possibly somewhat higher than some results which have been published; but I claim that the cost is considerably less than it would have been if the current had had to be paid for at (say) 6d. per unit from a supply company.

So far I have avoided entering upon the somewhat vexed question of the relative economy of gas and steam engines for central electric lighting stations, and also the debateable question as to whether it would be expedient to introduce differential prices of gas for motive power, with a view of inducing customers to develop the use of gas-engines more freely. They are both points, I am well aware, which have been fairly well thrashed out prior to this date; but perhaps one reference more will, if it does not produce any apparent good result, not do harm.

It is a somewhat difficult matter to understand the attitude of certain eminent electrical experts, who appear to take up the position "what good thing can come out of"—gas. It appears to me to be like "cutting off their nose to spite their face." It is a well-known fact that, for the greater portion of the 24 hours, the average electric generating station is standing idle, so far as the output of current is concerned. All this time, however, with steam power, they are compelled to incur certain expenses in order to keep their plant in hand, which the use of gas-engines would entirely obviate. It has, of course, been advanced that the running expenses of a gas-engine are much heavier than for steam power; but I do not think that, with the most efficient and modern type of gas-engine, this objection has yet been justified. I should have thought that the fact of having a source of power within reach, and absolutely reliable at all hours, would counterbalance many other little details. But "No," say they; "we commenced electric lighting with the fixed idea we were going to extinguish gas; and now, if we cannot extinguish you, we are certainly not going to help you by consuming your product, even if it is to our own disadvantage not to do so." Following a natural law, however, most mundane affairs ultimately gravitate to their proper level; and, if I may be allowed to assume the prophetic mantle for a moment, I anticipate that the gas-engine will ultimately gravitate into all the small and moderate-sized stations, and supplant steam power, at least for the purpose of generating electricity.

That there are possibilities for gas-engines of large power coming to the front also is evinced by the fact that the River Wear Commissioners at Sunderland during last year introduced several of Tangyes' gas-engines of 120 maximum indicated horse power each, coupled direct, without intervening belting or gearing, to centrifugal pumps for emptying a graving dock; and I believe I am correct in stating that the installation has so far proved itself very efficient and convenient. This installation is the more noteworthy on account of its being probably the first of its kind that has yet been introduced.

With regard to differentiating the rates of supply for the purpose of encouraging the use of gas as a prime mover, I have, through the courtesy of some 126 of my *confrères* in the profession, been able to schedule that number of individual expressions of opinion on the subject; and a most interesting examination it has been. I find that, out of the 126 replies received, in only 18 undertakings has the principle been admitted, and of these there are only two where it has been adopted for motive purposes purely and simply, and two for cooking—the balance of 14 having adopted it for cooking, heating, and motive power generally. A query inviting an expression of opinion on the advisability of introducing the system brings out 18 direct negatives and 12 who are uncertain; and 96 do not deal with the point.

Among those who have introduced the system, the utmost diversity of opinion exists; some expressing the intention of returning to a fixed charge throughout at the earliest possible moment, while others consider it to be most helpful in increasing their consumption. In one notable case, where the price for lighting purposes is 4s., and for cooking, heating, and motive power 3s. 3d. per 1000 cubic feet, the consumption under the latter three headings is returned at 50 per cent. of the total annual consumption. The following table shows the total annual consumption, together with the consumption under special rates, and the respective prices charged per 1000 cubic feet in some selected cases where a differential rate is in use. These returns are certainly of much interest; but, unfortunately, they do not provide sufficient data from which to draw a safe deduction as to whether a differential rate for gas for motive power would be an advantage or otherwise. Turning again to the report of Herr Korte, I find he states as follows: With gas at the rate of 5s. per 1000 cubic feet, and no discounts for motors, the annual consumption was under 4 million cubic feet per annum; but with an allowance of 10 per cent. in 1885, and since increased to 33⅓ per cent., the present rate of consumption is over 18 million cubic feet.

Town.	Total Annual Consumption.	Annual Consumption under Differential Rates.	Price. A—Ordinary. B—Differential.	Remarks.
	Cubic Feet.	Cubic Feet.		
A.	150,000,000	4,000,000	A. 3s. 4d. B. 2s. 10d.	.. Gas-engines only.
B.	550,000,000	53,396,000	A. 3s. 7d., less 5 p. ct. B. 2s. 9d. „ „	Gas-engines and cooking.
C.	35,000,000	2,700,000	A. 4s. B. 3s. 10d., 3s. 8d., 3s. 6d. according to quantity.	Gas-engines only.
D.	135,000,000	11,190,000	A. 3s. 3d. B. 2s. 6d.	Gas-engines and Cooking.
E.	192,000,000	13,135,000*	A. 3s. 0d. less 5 p. ct. B. 2s. 0d. „ „	Cooking, heating, & motive power.
F.	560,000,000	20 per cent.	A. 2s. 9d. „ „ B. 2s. 0d. „ „	Do. do.
G.	36,000,000	10 „ „	A. 3s. 6d. [discounts from B. 3s. 4d. 2½ to 20 p. ct. according to quantity.]	Do. do.
H.	143,000,000	30 „ „	A. 2s. 10d. gross. B. 2s. 6d. „ Discounts allowed equally.	Do. do.

* Consumption increased from 3,227,400 cubic feet to above since the introduction of differential rates in 1890.

Upon this as upon most other questions there is, no doubt, something to be said *pro* and *con*. To these companies who are working under *ægis* of the sliding-scale, it is, of course, out of the question; and with some others, certain clauses in their Local Acts practically prohibit them entertaining the idea. But municipal undertakings, as a rule, are not troubled by such as these, and not all

companies. It therefore becomes a question as to whether it is expedient to encourage this class of consumption at the expense of other classes, as, of course, differential rates must mean the taxing more or less, as the case may be, of the rates above them. From the point of view of the economy of the gas-engine as a motor, the lower the rate at which the gas can be purchased, the stronger must our case be against other competitors in this particular field. But, looking at the matter from an impartial point of view, it appears to me that the weight of evidence is on the other side. Personally, the opinion I have formed is that perhaps the most rational way, on the whole, is to keep down the working expenses by all legitimate methods, improved appliances, and careful management, and reduce the price of gas to the lowest possible figure all round; to rely upon the efficiency and construction of the engines to give a high relative duty; and to induce our customers to accept the gas-engine upon economical grounds, as the only satisfactory motor for trade and industrial purposes. The principle of hiring gas-engines on the same lines as cookers, &c., is worthy the careful consideration of all boards of gas directors and committees. I feel sure there are many people, who cannot see their way to purchase an engine and all its accessories outright, who would welcome the option of hiring one at a reasonable quarterly rental. I believe and trust that, if the high results to be obtained from this class of motor are kept constantly to the front, and proper facilities offered for their adoption, we shall see their use very greatly extended within the next few years.

PRINCIPLES GOVERNING THE TRANSFER OF GAS UNDERTAKINGS.

By E. H. Stevenson, M.Inst.C.E., F.S.I., &c.

I am afraid that the title of this paper will raise expectations which will not be satisfied; as there is so little to be said for dry abstract principles, unless life be infused into them by discussing concrete cases, when very often they do then turn out to be somewhat exciting. In this case, there is not very much to be said upon these "dry bones" of principles, although if there be any discussion they may receive a clothing of flesh; but the paper will not be long enough to tire anyone who is blessed with even ordinary patience—dealing as it does solely with the transfer of gas undertakings from companies to local authorities.

Such transfers are an every-day occurrence; while it is very rarely that undertakings are transferred from companies or private individuals to other companies. The principles which govern these transfers are very simple; but although so simple, they require a certain amount of experience and considerable care in the application of them. In the author's experience, no two cases are exactly similar; and therefore, in ascertaining the value of an undertaking, it is requisite to consider not only what may be called the ordinary methods which apply to every case, but also whether there are any unusual circumstances bearing upon the particular instance in point.

There are, according to the opinion of a well-known expert, as stated in a recent case before a Parliamentary Committee for a compulsory purchase, only three methods by which transfers may be effected. One is by the local authority agreeing to pay the value placed upon the undertaking by the company; the second, that where the company is willing to sell, and the parties cannot agree upon the price, an arbitration should take place to ascertain the value; and the third method is where a company is compelled, by the authority of Parliament, to sell its undertaking. The second course he considered ought never to be adopted by a company, and the third should never be forced upon one; but, "the only way in which the transfer of a gas undertaking should ever take place is by the local authority agreeing to pay the company's price."

The principle governing this latter course is very simple. It is to ask the highest price that the purchaser will probably pay; and the more eager the local authority is to acquire the works, the larger should be the price demanded. It is not necessary to dwell further upon this principle, because it is so very easy to work out; and it is believed that there is not a case known of a gas company asking less than, in their own opinion, their undertaking was worth. The other two methods are practically in the same category; for whether a company agrees to sell by arbitration, or has arbitration forced upon it, it comes to the same thing in the end, except that in the latter case there is usually a claim made for compensation for compulsory sale.

In nearly every case where compulsory power has been granted to a local authority to acquire a gas undertaking—and in the author's opinion there have been such cases, though many engineers and others interested in gas companies will not admit it—Parliament has inserted an arbitration clause under the Lands Clauses Act, 1845. But in two instances—namely, those of Glasgow and Rotherham—the Committee decided the value of the undertakings; in Glasgow granting a rather higher rate of perpetual annuities than the Corporation proposed by the Bill, and in Rotherham confirming the value that the Local Board (as it then was) had placed upon the undertaking.

There is very little doubt that in most cases a much fairer decision is arrived at as to the commercial value of these matters during the course of an arbitration than by agreement, unless the company will grant to the advisers of the local authority free access to their works and books; for the market value of shares may not give any clue to the real value of the concern to be sold, but may be either considerably above or below such real value. If, therefore, a company has any weak points, which, if known, would tend to decrease the value of their stock, they would be wise to strenuously object to going to arbitration; but where there is nothing to hide, an undertaking cannot be diminished, but would probably be enhanced, in value by having the true facts fully disclosed.

In the case of statutory companies subject to only ordinary conditions, and paying their maximum or standard rates of dividend and charging somewhat below the maximum or standard price of gas, the points in dispute between the parties usually resolve themselves into the number of years' purchase of the dividends which should be allowed, and, where there is a standard rate of dividend, whether there should or should not be an allowance for prospective profit. Even the first point gives opportunity for considerable divergence of opinion; and, indeed, it may be stated that the amount asked for by a company has been as much as is equal to 35·4 years of the maximum dividends, whereas only 25 years' purchase was offered. When the question of prospective profits is brought into the calculation of value, the difference between the views of the seller and the buyer is practically unlimited. To show how far apart valuers may be in their estimates of the real value of an undertaking, it is only necessary to mention the facts in a recent case of arbitration, where those acting for the company stated the value to be (after making the correction on account of repairs and renewals) as high as 58·75 years' purchase of the profits, and those for the purchasing authority as low as 15·82 years; the latter being due to the fact that it was considered the price ought to be reduced and an allowance made therefrom, and the former value being largely due to the capitalized value of the estimated prospective profits.

The cases which give rise to most dispute are: (1) Those few statutory companies which have an abnormal amount of capital (either extraordinarily large or correspondingly small); (2) statutory companies which are not paying their maximum or standard rates of dividend; and (3) non-statutory companies. For it is in these cases especially that either incompetent management or unfortunate circumstances, over which the company may have had no control, may occur; or it may be that a non-statutory company will not be satisfied with a reasonable amount of profit.

In all these three classes it is necessary to ascertain the maintainable profit which a company can reasonably be expected to make in the future, having regard to all the circumstances of each case; and the word "maintainable" is here used because it is very common for statutory companies that either have an excessive capital or are not paying full dividends, and also for companies that are not restricted as to profit, to neglect the proper repair, maintenance, and renewal of their works and distributing apparatus. It is only human nature that occasionally companies should act in this manner, so that they may be able to pay a higher dividend than could have been legitimately declared if all the obligations of the concern had been properly met—altogether forgetting that sooner or later such neglect will bring disaster in its train.

or trusting to the vain hope that the future increase of the business will bring about an improved state of things. The author has found that, in nearly every case coming under these three clauses, the works have been to a greater or less degree starved, and that the unaccounted-for gas is more than it should be.

It may be taken as a *general* rule that this is the only item which can be seriously challenged by either side; but there are exceptions, in which companies have neglected to make other proper charges against revenue, and which, when an undertaking is sold, have to be brought into consideration. The first thing, therefore, which a vendor or purchaser has to do in these instances is to carefully examine the accounts; and if the charge for repairs and renewals is not normal, having consideration to the situation of the undertaking, then to make the proper addition to or deduction from the profit as shown by the balance-sheet. It is very seldom that there is much difference of opinion as to the amount to be deducted or added; and it is usually recognized by both sides that this correction of the accounts should be made. It may be, also, that the price of gas is excessive when compared with other undertakings in the neighbourhood; and the purchasers not infrequently demand that a further deduction be made from the profit on account of this. Having thus corrected the accounts, the number of years' purchase has to be determined; and this is governed, first, by whether the company be statutory or non-statutory, and, second, as to whether there are any unusual circumstances in the particular case.

Having thus capitalized the maintainable profit, the purchasers may consider that a deduction should be made for putting the works and plant into order to earn the profit; for it is quite possible—and, indeed, in some cases more than possible—that, in consequence of past neglect, the works or the distributing apparatus may have suffered so great deterioration that the ordinary annual expenditure would not suffice to reinstate them in good working order. If this be so, it is apparent that, in justice to the purchaser, either the necessary expenditure should take place before the works are handed over, or a sufficient amount be allowed for the purpose.

A last correction may be necessary in the case of non-statutory undertakings in the event of the apparatus and plant upon the gas-works being either in excess of, or deficient in, the maximum daily quantity of gas sent out. For example, a works may, after allowing a sufficient power as a fair margin, have an excess of retort power or gasholder room; and in that case the value of the retorts and that portion of the house containing them, and the value of the excess in gasholder capacity, will have to be added to the purchase price. On the other hand, it very often arises that the gasholder capacity is considerably below the maximum day's supply; and it is hardly ever disputed that the cost of constructing another gasholder to increase the holding capacity to bring it equal to the maximum day's supply should be deducted from the otherwise ascertained value of the undertaking.

Having now dealt with the principles which govern these transfers, it may be of interest to state, as examples of the difference of value which arbitrations have shown to exist between various undertakings, that awards have varied from as high as 29 years' purchase of the dividends to as low as 14·75 years for statutory companies, and from 23 to 12·72 years in other instances; and these variations are largely, if not entirely, due to the circumstances of each case.

LETTING GAS APPARATUS ON HIRE.

By Norton H. Humphrys, Assoc.M.Inst.C.E., F.C.S.

The adoption of the plan, in one form or another, of assisting the consumption of gas by letting out appliances on hire, is now becoming so common among gas companies, that a few considerations suggested by some years' experience may not be out of place.

It became the usual thing, so far as gas-meters are concerned, at a very early stage in the history of our industry. Consumers objected to pay down a cash price of some pounds for an article that was of no direct or evident service to them; and, on the other hand, the vendors of gas discovered the desirability of keeping the control of the meter in their own hands. But with one or two notable exceptions, the hiring business stopped at this point for many years; and it is only within comparatively recent times that it has been extended to take in gas-stoves and sometimes other appliances. It is to this class of business that the following remarks are intended to apply; the meter business being a special branch that requires to be dealt with in a special way, as for obvious reasons the meter cannot be classed with gas-consuming apparatus, though some of our customers might think it would be rightly placed.

The hiring department is not entered upon as a direct source of profit, like the utilization of residuals or the crushing of coke. I question whether in any case a fair balancing up of income and expenditure over a period of several years' working would show a result on the right side. Nor would it be wise to look to the hiring department for a substantial contribution towards the balance available for profit. The chief object in view is something beyond placing out as much apparatus as people will take. It is the securing of a particularly profitable line of business—such as summer or day consumption—which enables an increased annual output to be met without a proportionate addition to the capital account. Practical experience has shown that this is only one of many advantages that are secured; and hence the popularity of the hiring system. The manager of the gas-works is brought into closer touch with his customers, and is enabled to acquaint himself with their views and requirements in a way that would not otherwise be practicable. If judiciously worked, its introduction will be accepted as an act of grace on the part of the gas company, and as evidence of a desire to meet the needs of the customers, even if some trouble and expense are necessary to do so. It encourages a good feeling all round, and shows that the sellers of gas have a soul that rises to higher things than the mere pocketing of as much of the customers' cash as the Act of Parliament will allow them to take. The better impression that now exists towards gas companies, as compared with the popular opinions of fifteen or twenty years ago, may be partly credited to the introduction of the hiring system. So this plan may be regarded as an advertising line that no undertaking desirous of keeping abreast of the times, and making the best of its resources, can really afford to ignore.

Another benefit that has followed the introduction of the hiring system, is the active enterprise that it has been the means of promoting among manufacturers of gas appliances, which has told in favour of the consumer as well as of the seller of gas. The possibility of obtaining large orders from gas companies has furnished an inducement that is not supplied by the ordinary wholesale and retail trade; and the makers have received every encouragement to turn out a well-made, strong, and efficient article. The gas companies, knowing the responsibility they are undertaking, are keener and more judicious purchasers than the average householder. Handsome outlines, elegant ornamentation, and other attractions of a shallow nature (that are good enough to draw an ordinary purchaser), have had to give way to something of a more substantial character. An American gas engineer lately complained that the public did not value efficiency, and would not give even a shilling more for a better made article that would be more durable and use proportionately less gas. But makers have appreciated the fact that the goods required for hire must be strongly made, simple, and easily kept in order, and not wasteful or extravagant in the matter of gas consumption. The result is that no one need hang back from the hiring business on the ground that suitable apparatus cannot be obtained; for there are several well-known makers whose goods can be relied upon to give satisfaction, and to last, under reasonable working, long enough to pay for themselves.

As in the case of advertising, it is possible to be so niggardly in the matter of hiring that the anticipated benefits, if realized at all, are only partly gained, and, on the other hand, to be so prodigal that the outlay is two or three times as much as is necessary. In most districts, its introduction will be well received and promptly accorded a generous patronage. This apparent success may be the means of laying the foundation for future trouble; and in forcing the capabilities of the available staff, in order to meet all demands promptly, mistakes may be committed that are not so easily rectified.

Everybody concerned must keep prominently before him the fact that something more than the mere establishment of a large hiring trade is in view, and that the

free and easy distribution of apparatus to all who apply for it is a very costly way of securing the desired results. An insurance company that accepted every proposal received, without inquiry, would soon experience heavy loss; and while a proposal to hire a stove is scarcely such a serious matter as an insurance policy, still it is worth while to take some trouble in considering each application on its own merits. In fact, I question whether it would not be a good plan to keep a regular form for signature, in which a reasonably steady and regular use of the appliance is made one of the conditions of hiring. For two things soon become evident—first, that many customers do not object to hire an appliance at a small rent simply to be kept in readiness for emergencies; and, secondly, that the hiring system is popular among those long-winded customers who suffer from a chronic tendency towards the arrears list. Therefore it is well to have a distinct understanding from the first, that there is no obligation to let on hire, and that a consumer has no legal right to call at the gas-works and demand apparatus on hire on the same terms as he can call for a supply of gas; but rather that each application will be fairly considered on its own merits, and accepted or declined as may appear desirable. In any case, it is well to make a rule that apparatus should not be hired to parties who are habitually behindhand in their payments.

It is especially at exhibitions that the necessity for these precautions arises. The salesmen are rightly anxious to place as many goods as possible; and some difficulty will arise if they are allowed a free hand in the matter of pledging the gas company's credit by the indiscriminate acceptance of all and every application for hire. Let them sell freely, by all means, on cash terms; and let them receive as many proposals for hire as they can get. But it must be understood that the gas companies' officers will subsequently investigate each case. If the salesman does happen once in a way to waste half-an-hour's eloquence on a countryman who has casually dropped in because he is on a visit to town and wants to see everything, but who has never resided within ten miles of a gas-works in his life, the company suffer no harm. But the case is different if a simple-minded person is persuaded to take an unsuitable or excessively large appliance that will use more gas than he can conveniently pay for; or if a valuable article is entrusted to a party of shady credentials, or who is frequently travelling or away from home. If the company are in the happy position of being able to afford to be liberal, surely it is worth while to take care that their favours are bestowed where they will be appreciated, rather than to follow a "rough and tumble" system of serving all alike. They must keep a free hand. Sometimes it is necessary to decline hiring altogether; and, in other cases, special concessions can be made with advantage.

It is well to recognize at the outset that the investment in apparatus for hire is subject to special risks. Ample allowance must be made for wear and tear, as people do not care for hired goods as they do for their own property, though cases of wilful or reckless injury are quite exceptional. The chief danger to be guarded against is the accumulation of useless and idle stock, or of goods that are out of favour as being old-fashioned. The consumers strongly appreciate the fact that hired apparatus can be sent back at any time. The numerous improvements that have followed each other during recent years have increased the difficulties in this respect. With the new enamelled cooking-stoves on view, it is a bad job for anyone who has a large stock of second-hand sheet-iron cookers on hand. Deceases and changes of residence result in stoves being returned, so the possibility of accumulating stock is an ever present danger. It is not safe to supply anything of a special character on hire; but only such appliances as are in general demand in the district. The variety of apparatus, and the number of sizes of each variety kept for hire, should be carefully limited according to the magnitude and class of business done. A very small undertaking should not hire out more than a few medium sized stoves; and for districts of anything under 1000 consumers, it is a good rule to keep to one make of stove or gas-fire, and to have special terms for either very large or very small sizes. In our large towns, where stoves are let out by the thousand, these considerations do not apply; and other questions, such as those of supply and demand, come in.

In any case, the hiring department should be under competent supervision; and when the number of appliances let out begins to be counted by the hundred, it requires more care than the manager of the gas-works, with his numerous other responsibilities, is able to bestow. It is not sufficient to serve out the apparatus and leave the customer to do what he likes with it—trusting him to complain if anything is wrong; but the apparatus should be inspected at periodical intervals, varying from a month to two years, according to circumstances. In practice, the gas company are responsible for the fixing and proper action of the apparatus, as well as for maintaining the same in an effective state. Gas-fires or gas cooking-stoves do not cause much trouble; but with some classes of apparatus—such as high-power lamps—regular attention is required. The hiring department, therefore, means an important addition to the responsibilities, and calls for additional store-rooms, workshops, and a staff capable of executing ordinary repairs, in addition to being able to fix the apparatus promptly and efficiently, and to advise the consumers generally.

I prefer to include the cost of fixing as a part of the investment, and in ordinary instances relieve the customer of all trouble and expense as regards fixing. But in particular cases, where a long length of pipe is required, or where gas is not already laid on and will not be used for anything else, a special charge is made. For hiring purposes, the cost of the stove must therefore be regarded as including the necessary pipe, fittings, and labour for fixing it; and the cost, of course, governs the charge for hire. If a customer wishes an appliance put in a place where it will be ineffective or a cause of nuisance, it is better to refuse to fix it, at the risk of losing his order. Every piece of apparatus that is acting efficiently is an advertisement in itself; and the same applies also to every defect or failure.

Appliances for hire can scarcely be ranked as permanent capital, though there is no objection to a reasonable proportion of their cost being charged to capital. They may be classed in the same position as tools or retorts, which are replaced at the cost of the revenue when obsolete or worn out; but I prefer to regard them as floating capital, by keeping them in the stock account. On one side, we have the first cost of new appliances, including fittings and accessories, if provided, and the cost of renewals, maintenance, &c.; and, on the other, the receipts for rents. Receipts for stoves sold, or special charges for fitting, are deducted from the cost of new appliances. The results of a year's working then come out in the form shown as follows:—

_____ Gas Company.

Hiring Department.

To New appliances, pipes, fittings, &c., for hire—			By Rents received during year	£125
Balance from last year . . .	..	£1000	Balance to next year .	1025
Expended on same this year	£150			
Less appliances, &c., sold . . .	50			
		100		
Repairs, maintenance, &c., materials and labour, including new appliances in place of old . . .	..	50		
		£1150		£1150

In any case, it is desirable to make a separate account of the expenditure on the hiring department, both for additions and for current expenses, so that at any time its position can be reviewed, and the hiring charges re-arranged if necessary.

Taking the actual expenditure on goods for hire, inclusive of labour and material for fixing, a reasonable rental for a gas company to charge is 10 to 12 per cent. for cooking-stoves, 15 to 20 per cent. for heating-stoves, and 20 per cent. for high-power lamps. Heating-stoves should be charged at a higher rate than cooking-stoves, because they are only used intermittently during the winter months, and therefore do not represent a specially remunerative class of business; and high-power lamps need more frequent attention in the way of maintenance than stoves. At these rates, the hiring department will be about self-supporting, without allowing interest on the capital

invested. But special circumstances may arise—as when the manufacturing and distributing plant is in excess as compared with the actual business done—which render it advisable to make some reduction on the above rates, in order to push business in particular lines. On this point, however, no general principles can be laid down. I do not believe in short-period hiring, except at special and directly remunerative rates; but I make it clear that the object is to obtain, not temporary sales, but a solid and permanent business. So no appliance is let for less than twelve months at ordinary rates, though special arrangements may be entered into for short periods. There is occasionally a disposition to "try on" for cooking-stoves in the summer only, and for heating-stoves in the winter; but anything of this sort is decidedly opposed. The amount due for rent is made up to each quarter-day, and charged with the gas.

At Salisbury, there is now the following apparatus out on hire: 262 cooking-stoves; 7 boilers; 26 gas-fires; 170 high-power lamps—total 465.

The cost of these, including fixing and every expense, was £2700; and the annual cost for repairs and renewals was £100 to £120. The receipts for rents are £235 per annum. Of the expenditure, £1000 has been placed to permanent capital; and the balance stands in the stock account, and at present amounts to £400 or so. Nearly half the total cost has therefore been paid off; and the greater part of this repayment has come from the rents received. Therefore, after paying all maintenance expenses, a balance of over £100, or (say) 7 per cent. on our actual capital concerned, remains. I propose to apply this to the extinction of the stock account; and after this is done, I shall consider it may legitimately be appropriated as profit. Though we have a large investment for our district of 1600 customers, it is now self-supporting; while the additional summer and other consumption is a useful help towards the prosperity and security of the business. I should like, in conclusion, to mention that the hiring system was introduced in Salisbury by the late Mr. Thomas Hardick nearly thirty years ago.

THE POPULARIZATION OF GAS.

By A. Dougall, of Tunbridge Wells.

The subject which I am to bring before the Institute cannot lay claim to scientific interest or novelty of any kind; but I trust it may give rise to a discussion which will be both interesting and profitable to the members generally. The popularization of gas is a comprehensive subject; but it is my intention to confine my remarks to that part of it relating to the coin-meter system, which has not yet been brought before this Institute in the form of a paper.

By this system, we are introduced to a new class of consumers who were, by force of circumstances, unable to avail themselves of the advantages of gas under the old dispensation. The restrictions placed upon the supply of gas by requiring deposits, payment for services, meters, and fittings, together with the prospect of a quarterly account, formed obstacles not to be overcome by the artizan and working-class population. The invention of the coin meter at a time when gas was brought into keen competition with cheap oil on the one hand and electricity on the other, was hailed as the solution of a problem which had long exercised the attention of gas engineers. The readiness on the part of gas companies and gas committees to adopt the new meter, stimulated inventive genius; and there are now many coin meters of a reliable nature.

When it was first proposed to introduce the new system into Tunbridge Wells, it was thought that there was little scope for it in a residential town; and that it was more likely to succeed in industrial places, with thickly populated districts. On examination, however, it was found that the houses where gas was used were fewer in number than those where other illuminants were employed. In the year 1891, out of 5300 inhabited houses, 2925 were without gas. With these facts before them, the Tunbridge Wells Gas Company decided to give the system a trial, and agreed to fit up, free of cost, houses where the annual rental does not exceed £20, and the distance from the mains is not beyond 50 feet. Under this arrangement, the Company lay the necessary service-pipe, fix a coin meter, and run supplies to four different places; providing one telescope pendant, two brackets, and a small boiling-ring or cooking-stove.

The work of fitting up the houses was let to a thoroughly reliable contractor, with whom the following agreement was made:—

ARRANGEMENT *for Fitting Up Small Houses, the Rental of which does not exceed £20 per Annum, under the Coin-Meter System.*

The Company will lay service, fix meter, and supply pendants, brackets, boiling stoves, tube backs, wood blocks, nose pieces, burners, flexible tube, composition pipe, hooks, and other fittings required.

The Contractor will provide all tools, nails, screws, solder, and other materials necessary for connecting up outlet of meter and running supply to four separate places in each house. He will also cut away, and afterwards make good, all needful plaster, woodwork, brickwork, paint, and paper, and complete the work to the satisfaction of the Gas Company's Inspector. He shall be paid the sum of eight shillings (8s.) for each house so fitted up; or such a sum as may be agreed upon, when the full amount of work, as above stated, is not carried out.

He shall also be paid an additional two shillings (2s.) as commission for each new consumer obtained by him, for which he shall obtain the signature of the Landlord to the printed "Form of Consent" provided by the Company, inquire into the respectability of the applicant, and report all orders and information to the Gas Company's offices.

The local directory was brought into requisition; and all houses not already supplied with gas were marked. A handbill announcing the new departure was left at each of these houses; and a few days afterwards the contractor called and explained more fully the working of the system. After this, the applications came in so quickly that it was difficult to execute the orders as promptly as the clients wished. The demand for coin meters all over the country taxed to the utmost the resources of the manufacturers; and, even if desired, it would have been impossible to obtain from any one maker a regular supply in anything like reasonable time. A plan, however, was adopted of dividing the town into districts—a different make of meter being used in each; and in this way, the difficulty of obtaining the requisite number was overcome. In the event of any complaint being made, this plan has the further advantage of enabling the inspector to tell, without reference to his book, the maker of the meter in fault.

In very few instances has the introduction of this system necessitated the laying of new mains. As a rule, a pipe supplying public lamps and occasional consumers in the ordinary way, and large enough for the fresh demand, was already there; so that in our case the expenditure under this head was small. New services, however, have been required; and to supply the 1600 consumers under the new system, over 8 miles of wrought-iron tubing have been laid, or about 28 feet per consumer. Remembering how quickly this tubing oxidizes in some earths, the cost of renewing must be taken into account; for although it may be said that the length of the service to these consumers is not greater than that to ordinary ones, yet it must be remembered that the quantity of gas used by them is only small, and that the proportionate cost to the Company is therefore much more. Defective services have much to answer for in increasing the leakage account; and where this system is extensively adopted, there must be more loss from this source in the future. In Tunbridge Wells, the average consumption is 60,863 cubic feet per ordinary consumer, and 9918 cubic feet per consumer under the new system. Reckoning the length of service-pipe in both cases to be the same, the loss by leakage would be increased from the source indicated.

The fixing of the meter in a place convenient to the Gas Company, and at the same time acceptable to the fastidious tastes of our new consumers, is not always an easy matter. In the majority of cases, the front room is selected, as being the most convenient place to run the service to; but where part of the house is sub-let, and the meter is under the control of one of the occupants only, difficulties arise. The lodger may go out and lock up the room containing the meter; and thus prevent the tenant putting in his coin in the event of that operation being necessary. Though it may be easier in the first instance to put the meter in the front room, it is advisable, for the satisfactory working afterwards, to fix it in a place where it can be readily got at by all concerned.

From the meter, composition pipe was at first used entirely for piping the houses; but its liability to sag, and the risk of leakage by nails being driven into the pipe, led to the use of a combination of iron and composition

—the iron being used under the floors, and the composition on the walls. The fittings supplied to such consumers should be strong and good; the annoyance and expense occasioned by cheap fittings should be guarded against. When a company undertakes the oversight of such a large number of the consumers' internal fittings, the importance of securing in the first instance strong and well-made ones must be apparent to all. Money laid out in this direction is well spent. To many gas companies this new departure will entail an extra staff of men to attend to the appliances on hire. A periodical inspection of these must be made to ensure satisfaction; and fittings must often be brought to the workshop to be overhauled and put in order. Burners, which have so much to answer for in the wasting of gas, must be renewed from time to time; and some cheap form of governor burner should be supplied.

As far as lighting is concerned, these consumers would not be worth securing; their requirements in this direction being so limited. The convenience of gas as a heating and cooking agent is, however, highly appreciated by the working classes; and it is because of this that the new departure can be made remunerative. The readiness and facility with which a supply of hot water can be obtained by means of the boiling-ring, make it a great boon to such people; and I believe it was mainly on account of this that the coin-meter system found favour in its early days, and has since grown to be so popular with the class for whose benefit it was conceived. We do not, however, stop at the boiling-ring, but lend, free of charge, cooking-stoves, tailors' irons, &c., to those consuming gas under this system; looking to the increased consumption of gas for a return on the additional outlay. Of the 1600 consumers with coin meters, 882 have cooking-stoves; and I believe, in the near future, a much greater number will be supplied with these stoves. It encourages day consumption, which all are anxious to cultivate.

Gas compares very favourably with coal bought in small quantities—especially when it is directly under the control of those paying for it, and not subject to the wastefulness of servants. Much ignorance prevails with regard to the use of gas cooking-stoves; and the gas exhibitions which are now so common in our towns do not reach a large section of those who specially need instruction. They will not attend demonstrations of cookery, which are often beyond them; and we have therefore decided to give homely lessons in cooking by gas in various parts of our district. These will be given, not by a professional cook, but by the wife of a working man, who is well up in the subject, and possesses a natural aptitude for imparting to others what she herself knows. It is intended to engage a room, and invite those in the neighbourhood to attend these lessons in a homely way. By such means, practical knowledge will be spread among a class who, by reason of the exigencies of their position, cannot otherwise obtain it.

I believe the time has arrived when purveyors of gas should undertake gas-fitting in all its branches. Ironmongers nowadays, anxious to keep abreast of the times, are too ready to recommend their customers to have their houses wired for the electric light, rather than piped for gas; and it behoves us to look after our own interests in this matter. Where there is a staff competent to deal with the fittings of prepayment consumers, the work of fitting up other houses under the ordinary system could be managed without much addition to that department.

There are in Tunbridge Wells a considerable number of houses of a rental from £20 to £35 a year that are not fitted for gas; and it has been decided to extend the benefit of the system to these—substituting if desired a shilling coin meter. The expense of fitting these larger houses is greater; but the consumption is sure to be more, and in that way the additional expenditure will be justified. I am unable to give at present any reliable figures with regard to these larger houses; but I feel sure the application of the system to them is a step in the right direction.

When the popularity of the coin-meter system is thoroughly established in a town, it is well to announce to architects and builders that the gas company are prepared to lay the pipes for gas to be supplied under the coin-meter system in cottages during erection. Some landlords object to have their property pulled about by the laying of the necessary pipes; and in the case of new cottages, it certainly is mutually advantageous to have the pipes put in before they are finished. Gas is so popular with the working classes that there is little fear of the tenant not requiring it.

It is advisable to make monthly collections by intelligent collectors, competent to give advice in simple cases. The company will thus be in frequent touch with the consumers; their requirements can be promptly attended to, and more general satisfaction given. One of the difficulties inseparable from the coin meter is the discrepancy that is often found between the registration of the meter and the money found in the box. I do not refer to flagrant cases, where it is apparent that something is wrong, but to the small amounts of "shorts" and "overs." When a few coppers are short, it is impossible to convince the consumer that such is the case, and still more impossible is it to get him to pay the deficiency. The loss of confidence caused by pressing for payment is not to be compensated for by the recovery of these small sums, which only amount to about 1 per cent. on the prepayment rental, or (say) ½d. per 1000 feet. It is better to write off these deficiencies each year, and regard them as expenses incidental to the system.

To provide against loss in this way, it is a good plan to set the meter rather under the quantity allowed for a penny, and when there is anything over to return it at the end of each quarter. There is obviously no difficulty in dealing with an excess; but it is not so easy to recover a few pence that may be short. Various means of collecting the coppers are adopted, according to the amount to be dealt with. Our collectors have a strong lad with a bag; and in this way they manage very well. Tricycles and carts are used for such purposes; and no doubt, where the amounts are large, some such arrangement is necessary. It is rather a troublesome matter to dispose of these coppers. Some companies get their bankers to accept them for a consideration; but we find the tradesmen are glad to have them if we can give them half-pennies to mix with them, and these we obtain from the bank for the purpose in boxes of £20.

The cost of fitting these houses, including service and meter, has been £3 16s. 3d., and when a cooker was supplied, £5 16s. 3d.—making an average of £4 16s. 3d.; while the cost of connecting an ordinary 3-light consumer is about £2. From this source, therefore, there is an extra capital expenditure of £2 16s. 3d.; but inasmuch as this new business is obtained without any additional expenditure for mains, I think we might set the saving effected in this way against the extra expenditure indicated. If that be so, then there is no interest on extra capital employed to take into account. It will only be necessary to allow for wear and tear of meter and fittings, extra cost of collection and attention to meters, &c., to put these consumers on the same basis as ordinary ones.

Now, judging from the reports which have appeared from time to time in the "JOURNAL OF GAS LIGHTING," the consumption of gas by these consumers varies very much in different towns. The extra price charged to cover the expense of fittings is also a variable amount, and one which must be regulated principally by the average quantity used per consumer. The question naturally arises, What is a fair price? Take the case of Tunbridge Wells, where the cost and consumption are as follows:—

	Cost, including Meter, Pipes, Fittings, Boiling-Ring, Service, and Labour.	Average Consumption. Cubic Feet.
Without cooker	£3 16 3	6,189
With cooker	5 16 3	13,648
Average	£4 16 3	9,918

The price to the ordinary consumer is 3s. per 1000 cubic feet; and we give these consumers 21 cubic feet for a penny, which is about 11½d. more per 1000 feet. Now, 9918 feet at 11½d. = 9s. 6d., which may be hypothetically distributed as follows:—

Wear and tear	7s. 6d.
Extra collection and attention to meters, &c.	2 0

This I consider is a fair amount to cover the extra expenditure involved.

These prepayment consumers are specially satisfactory from a gas manager's point of view, as they take their supply uniformly throughout the year. This will be seen from the following figures:—

1895: Quarter ending—	Ordinary Consumption. Cubic Feet.	Prepayment Consumption. (1090 Consumers). Cubic Feet.
March	59,477,300	2,261,000
June	27,541,000	2,111,000
Sept.	27,921,100	3,452,000
Dec.	53,349,000	2,993,000

Taking this new business as a whole, it is remunerative from the first, and that is more than can be said of every new undertaking. The quantity of gas used varies very much, as will be seen from the following tables, which give separately the consumption by those who have cookers and those who have not :—

With Cookers.		*Without Cookers.*	
No. of Houses.	Cubic Feet.	No. of Houses.	Cubic Feet.
2 with consumption under	3,000	9 with consumption under	1,000
4	4,000	30	2,000
5	5,000	30	3,000
7	6,000	48	4,000
9	7,000	51	5,000
8	8,000	59	6,000
18	9,000	54	7,000
14	10,000	50	8,000
15	11,000	42	9,000
14	12,000	41	10,000
12	13,000	37	11,000
22	14,000	23	12,000
13	15,000	14	13,000
15	16,000	15	14,000
9	17,000	8	15,000
6	18,000	10	16,000
8	19,000	6	17,000
7	20,000	4	18,000
5	21,000	2	19,000
3	22,000	4	20,000
4	23,000	2	22,000
7	24,000	1	24,000
4	25,000	1	25,000
3	26,000		
2	27,000		
2	28,000		
1	29,000		
1	31,000		
1	32,000		
1	33,000		
1	35,000		
1	43,000		
1	64,000		
225		541	

These consumers have been burning gas during the whole year.

It is evident, from the above figures, that many of those who have cookers are not making much use of them. I am disposed to put this down, in most cases, to ignorance as to the proper management of the stoves, and would recommend district lessons in cookery to be given in the way I have already indicated, taking special care to secure the attendance of those who are most in need of such instruction. When stoves are lent free of charge, there are many ready to apply for them; but with the first difficulty, they lose heart and will not persevere, but simply go back to their old way of working. It will pay to take some trouble at first to instruct such people; for if once they get into the way of properly managing the stove, they will never return to the coal fire. Gas companies and corporations must, however, in many cases do more than simply fit up a cooking-stove free of charge. An artisan will sometimes pay as much as 7d. or 8d. a week for wood for his kitchen range; and surely if he can save that and the trouble of lighting a fire as well, he will, in the summer months at all events, find the gas cooker a great boon.

Until lately, we have had one agreement for the landlord and another for the tenant; but now we have adopted a combined agreement which is more simple, and which provides for a change of tenant without requiring a new form. A similar form is used by several companies.

Appendix.

Agreement for Supply of Gas and Hire of Fittings under the Prepayment System.

To the Tunbridge Wells Gas Company,

I,..... of .....
being the Owner of the Dwelling-house known as No.....
and situate in.....Tunbridge Wells, of which.....
is the Tenant, Do Hereby Authorize the Servants of the Tunbridge Wells Gas Company, with the consent of the Tenant, to enter and fix therein the Automatic Prepayment Gas Meter, Pipes, Stoves, and other Fittings mentioned in the Schedule hereto, and likewise at any time thereafter to enter to add to, repair, renew, or remove the same, the Company bearing the sole cost thereof, and making good any damage done to the premises in the course of fixing or removal; And I Hereby Acknowledge that the said Gas Meter, Pipes, Stoves, and Fittings are the property of the said Gas Company, and that the same shall not at any time during my ownership of the house be liable to distraint for any rent due from the present or any future Tenant of the said Dwelling-house.

Dated this.....day of.....189.....

Signed .....Owner.

And I, the said.....
the Tenant, hereby agree as follows :—

1.—That I will consume the Gas of the above Company, and pay for the same and for the hire and maintenance of the said Gas Meter, Pipes, Stoves, and Fittings, at the current rate charged by the Company, by depositing money in the Automatic Prepayment Meter provided by the Company.

2.—That I will give the Company immediate notice of any defect in the said Gas Meter, Pipes, Stoves, or Fittings; and I undertake that the said Gas Meter, Pipes, Stoves, and Fittings shall not be sold, removed, or damaged (fair wear and tear excepted) during my occupation of the said Dwelling-house.

3.—That in case of any defect in the Automatic arrangement of the Meter permitting more Gas to pass than is accounted for by the number of pennies found in the box, I hereby agree, on demand being made, to pay for such additional quantity of Gas as may be registered on the index of the Meter.

4.—That the Servants of the Company may enter at all reasonable times to collect the money, or to inspect, repair, or renew the said Gas Meter, Pipes, Stoves, or Fittings.

5.—That should I wish to cease consuming the Gas of the said Company at the above premises, I hereby agree to give the Company seven days' notice in writing of my intention so to do.

6.—That should the Company desire to cease the supply of Gas to me, or to remove any Gas Meter, Pipes, Stoves, or Fittings, for any other reason than that of improper use or fraud, they shall be at liberty to do so on giving me seven days' notice, in writing, of such their intention so to do; and the servants of the Company shall at any time thereafter, during my occupation of the said premises, be at liberty to enter to inspect, repair, renew, or remove the said Gas Meter, Pipes, Stoves, or Fittings.

Dated this.....day of.....189....

Signed.....

Tenant of .....

Schedule.

Automatic Prepayment Gas Meter No....
Main-Cock and Connections.
Pendant.
Brackets.
Burners.
Cooking-Stove.
Boiling-Stove.
Feet of Connecting-Tube.
Feet of Compo. Pipe with Blocks and all Connections.

[On the fly-leaf of the agreement are several forms for use in case of change of tenancy; thus obviating a fresh agreement.]

Specimens of the books used in this connection by the Tunbridge Wells Gas Company were upon the table for members' inspection.

Nitrogen Compounds from Coal Distillation.—Herre John Lundin describes in the "Teknisk Forenings Tiddskrift" some experiments by Herr Knublauch on nitrogen and nitrogen compounds from the distillation of coal, and also some researches on the same subject undertaken by himself. According to the "Chemiker Zeitung," he summarizes the results as follows: (1) About 50 per cent. of the nitrogen remains in the coke. (2) There is found again in the gas 30 per cent.; and, on account of its deteriorating effect on the illuminating power, it must be considered harmful. (3) From 12 to 14 per cent. was converted into ammonia, corresponding to 23 lbs. of ammonium sulphate per ton of coal. (4) Scarcely 2 per cent. (corresponding to 0·02 per cent. of the coal) unites with carbon and hydrogen to form hydrocyanic acid, corresponding to 3·1 lbs. of potassium ferrocyanide per ton of coal; two-thirds is, however, retained in the oxide purifiers. (5) Finally, 1⅛ per cent. is found in the tar as nitrogen bases, corresponding to 0·02 per cent. of the coal. (6) At the most, from 0·2 to 0·25 per cent. of the coal is converted into valuable nitrogenous bye-products, which yield a return of about 0·34d. per 1000 cubic feet of gas. The investigations were made chiefly on Westphalian coals, and with other varieties different behaviour might be expected.

The Temperature of Certain Flames.—At a recent meeting of the Chemical Society, the above-named object was dealt with by Mr. W. N. Hartley, F.R.S. Having for many years studied the nature of flames and the spectra they emit, he found no practicable means of measuring their temperature, owing to the disproportionate size of the measuring instrument (a thermo-electric couple, for instance), compared with the effective volume of the flame. He measured the temperature of flames by means of gold leaf and with fine wires of platinum 1-3000th inch in diameter, such as were drawn by Wollaston and used by Faraday; also with pure platinum wire 1-10000th inch thick. He furnished evidence of the high temperature of a candle-flame, not only from the melting of gold and of platinum in the flame, but by an examination of the spectrum to be seen in the mantle. Experiments made with platinum wires heated in a batswing gas-flame were described, which proved that the carbon does not lower the melting-point of the platinum in any appreciable degree. A small carbon monoxide flame melts platinum wire 1-10000th inch thick; and a cyanogen flame was shown to be intensely hot, for it melted such wire with extreme ease. The author expressed the belief that his experiments had dissipated the doubt that was cast on Professor Smithells' statement of the high temperature of the mantle of the bunsen flame, and confirmed his own estimate of the high temperature of the Bessemer flame.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1353.)

Business on the Stock Exchange during the past week was, on the whole, only quiet, although at times it took a spurt that looked as if it were going to generate some activity; and the tendency generally was rather dull. Towards the end, things brightened up considerably; and a favourable incident was the release of the four leaders in the Transvaal affair. But operators have recently been taught so many lessons in caution with regard to the actions of the Transvaal authorities, that no boom could be manufactured out of the incident. Fine weather had a good effect on home rails; but it also affected the attendance in the markets, and helped to keep things quiet. Among minor points were the buoyancy in beers, and the signs of a check to the cycle mania. The fortnightly settlement presented no special features; and its requirements had no effect on the Money Market, which remains in its persistent condition of extreme ease. Business in the Gas Market has been below the average on the whole. It opened with a good show of activity. But transactions soon fell away to some extent; and they remained somewhat restricted to the end of the week. With the notable exception of the chief stock in the market, the tendency was favourable; and several quotations made moderate advances in value. In Gaslights, the "A" opened well at 313½, and seemed disposed to remain steady. It gave way, however, in the middle of the week; and the quotation was put down a couple of points. Very little was done in the secured issues. But they were decidedly firm; and the debenture stocks came out a little higher *ex div.* South Metropolitans were strong and quiet; the "C" gaining two points. A couple of transactions in Commercial old showed its strength; and the quotation improved. The Suburban and Provincial group were almost stagnant; but Brentfords advanced. Among the Continentals, Imperial was active and unchanged; while Union made a nice advance, and European exhibited strength. The rest offered no remarkable feature. Business in the Water Companies was very quiet; but some slight advances in value took place. The reduction of the rate of dividend in Southwark has not affected the price.

The daily operations were: Gas opened briskly on Monday, which was the busiest day of the week. Prices were good; but quotations did not move. Tuesday was quieter; but good figures ruled generally. South Metropolitan "C" improved 2; Imperial Continental 3½ per cent. debenture, 1; and Cape Town, ¼. In water, Grand Junction debenture rose 1. Wednesday was a very quiet day, and nothing moved. On Thursday, there was a little run against Gaslight "A," which fell 2; but Commercial old advanced 2. New River Water was also 2 higher. Friday's business was very limited; but the general tendency was good; and several issues profited by *ex div.* quotation. On Saturday, transactions were at about the usual level. But prices were good; and the week closed well. Brentford old and new had a rise of 3 each.

DISCOVERERS, INVENTORS, AND IMPROVERS.

In its issue for the 8th ult., the "Engineer" had an article on a subject of perennial interest for all technicians, entitled "Education and Invention." This was the article to which brief reference was made in our recent commentary on the address, among others, of Mr. Windsor Richards to the Institution of Mechanical Engineers. It started with a commendation of Mr. Richards for denying to technical education the value sometimes claimed for it as a means of maintaining the industrial supremacy of the nation; and it went on to inquire whether it is not possible to have too much education and yet not enough. The bulk of the article is composed of evidence in favour of an affirmative answer to this question. The point is in regard to the tendency of technically trained and educated men to act in the spirit of Porson's gibe, and consider that what they do not know concerning their speciality is not knowledge.

The first illustration in support of this argument was supplied by a correspondent of our contemporary, writing on the subject of Dr. Hampson's process for the production of liquid gases by the reversal of the well-known practice followed for recovering the waste heat of furnace gases. This critic remarked that such an apparatus could not have been invented by a man of strict scientific training. The process in question is apparently thermodynamically baseless; and consequently nobody trained to regard the science of heat by the way of the text-books could have thought of it. The same remark applies to the origination of the regenerative furnace by Frederick Siemens. All the text-books stated that more heat was to be got out of fuel by burning it directly to carbonic acid than by partially oxidizing it to carbonic oxide and then burning this gas. When an observation to this effect was made by the present writer to Frederick Siemens himself, he only remarked quietly in reply that the professed authorities on Heat "did not know all about it." Here is the gist of the matter. The professor, the text-book writer, is justified in what he teaches only if, whenever the subject admits of it, he does not lose sight of the fact that he regards it from only one position. Unhappily, it is the inherent drawback of much technical training that it tends to obliterate from the mind of its possessor the power of perceiving the possibility of there being other standpoints than his own.

This, as our contemporary puts it, is the reason why a high scientific training is often, and in many ways, fatal to the exercise of the development of inventive genius. "It is simply that knowledge is too often assumed to have reached finality when it has done nothing of the kind; and the belief is fostered and inculcated by those who write books and treatises, and teach, in various ways." Not only the professor in his chair and the teacher in his class-room, but also the practical man in his office or workshop, is prone to think it lies with him to say the last word upon his own speciality. Of course, there is a wide field in which the knowledge of such a specialist stands him in good stead, and is capable, under proper inspiration, of producing much good and many novel results. Such knowledge as the professor and the technician possess is invaluable for keeping them and others who will be advised by them from ruining and making fools of themselves by attempting the obviously impossible. This knowledge, in short, is a guide and stay of inestimable value, when employed in tracing the way along well-trodden paths. It is like the art of "plain sailing" as understood by the ancient mariner, without which he could never have found his way from port to port across the trackless seas. But, like this knowledge, it contains no hint of the existence of a higher scheme of navigation, capable of shortening some voyages by a third of their traditional length.

The record of modern technics is full of examples of the technician being beaten at his own pursuits by the outsider. Our contemporary cites among others the development of the modern bicycle, with its suspended wheels, ball-bearings, and bizarre framing—all flat contradictions of the accepted mechanical principles of a quarter of a century ago. Then, again, there is the injector. "The announcement that Giffard was forcing water into a boiler by means of a jet of steam drawn from the same boiler, was received by every trained mind with shouts of derision; and months, if not years, elapsed before a theory of the action was formulated or accepted." It was the same with that very simple device the Pelton water-wheel, as compared with the turbine: "The man of high science produces the turbine—a very admirable invention; but the Californian miner, with practically no training, and plenty of water under pressure, proceeding on quite different lines, turns out a machine very much cheaper and simpler, particularly in the matter of installation, and one not less economical in the use of water." It is quite evident that a student of hydraulics who had learnt at college to regard the turbine as the acme of water-engines, would never have thought of making the Californian miner's "hurdy-gurdy."

Our contemporary argues that the quality of discovery, which appertains to every invention that amounts to a new departure in technics, is something that cannot be the outcome of training. "Let it be conceded, for the sake of argument for the moment, that the difference between an invention and a discovery is one of degree and not of essence, and we shall be able at once to understand why a rigorous and excellent scientific training may stifle invention. Such a training may be, and in mechanics at all events always is, fatal to discovery. It teaches that there is nothing left to discover. Everything is known that can be known, for example, about heat, and the steam-engine, and so on. If a carefully trained student proposes to himself to accomplish a certain thing in a particular way, his training may tell him that the thing he proposes to do cannot possibly be done, because the doing of it would break one of Nature's laws. The result is, of course, that he sits still and does nothing." There is some exaggeration here; but the statement is true in the main. It is the man who does not know that he is beaten (according to the text-books) before he starts, who accomplishes the impossible. Of course, the thing which he proposes to do, or which, as is frequently the case, suggests itself to him while he is looking for something else, must be possible after all; but this is as far beyond the scope of the text-book to predict as it is outside the experience of the practical man.

It is not, as our contemporary is careful to point out, the possession of knowledge which stops progress, but the mischievous assumption that the knowledge is final. "In other words, the training becomes too dogmatic—too monkish, if we may use the word. The young man finds it very difficult to believe or to understand that his teacher in the college, or his head in the office, does not know all that is to be known; and it is only human nature that he should subsequently take to himself the belief that he himself knows all about everything, and that if he thinks nothing can be achieved in a certain direction, nothing can be achieved at all. Yet it cannot, we think, be disputed that most of our leading scientific men know a great deal too much to invent anything; and so the world gets its steam, gas, and oil engines, its railways and high-speed ships, its power-looms and spinning-jennies, its horseless carriages and its telegraphs, not from the man of science, not from the teacher, but from the hard worker, who is continually trying new things, because he has never learnt that there is a law or a limit beyond which he cannot go. No doubt much time and money and labour are wasted; but in the long run the

world owes more to the man who does not believe in the impossible than it does to the man who sees it everywhere." This is in a large degree true; although the language is not to be read too literally, or as expressing anything more than one aspect of a large truth.

The gas industry is not without its own examples of this same truth, the most conspicuous of which are the incandescent burner, the gas-engine, and the regenerative furnace. It should be observed, however, that these were not the productions of ignorant men, such as too often crowd into the Patent Offices with their inchoate notions, but were the result of high ability and great knowledge applied from the outside to the solution of technical problems which the technical experts either did not believe to be capable of solution, or the very existence of which they did not suspect. The specialist, in short, is peculiarly liable to being "unable to see the wood for the trees;" but when it is shown to him—ah! then he is to the fore with his "improvements" on the original invention. This is in exact accordance with the observations of our contemporary. The specialist may be incapable of discovering anything; but he is certain to hunt down, in packs, any inventor who may be unfortunately advised in the matter of securing the property in his innovation upon established practice.

Such is the way of the technical world, and it is idle to complain of it. The original discoverer puts an affront upon all those who have been previously occupied in working along accepted lines. He ventures to tell them that they do not know their own craft; and they revenge themselves by displaying a remarkable aptitude for doing his business in ways which he did not foresee. In the result, it is all one to the world, which calmly proceeds upon its way, irrespective of the consideration as to whether or not those who have facilitated its progress have profited by their enterprise. The best service that an observer of these matters can render to those who are likely to become involved with them, is to exhibit these facts in their true light.

NOTES.

The Transmission of Heat through Plates.

Mr. A. Blechynden has continued the experiments respecting which he read a paper at the summer meeting of the Institution of Naval Architects in 1893, which had for their object the determination of the rate of transmission of heat through boiler plates. The investigation has proceeded upon copper and steel plates of equal thickness, but presenting different conditions as to brightness, cleanness, and smoothness. According to Rankine, who used Peclet's figures, the difference of the rate of heat-transmission through plates 0·5 inch thick does not differ materially from the two metals, whether clean or blacked. This view is upheld by Mr. Blechynden's experiments. His general conclusion is that a clean copper plate, with its surfaces as it comes from the mill, is about equivalent in heat-transmitting power to a steel plate with machined surfaces; or, that in the case of these two metals at least, clean metallic surfaces are about equal in heat-transmitting properties irrespective of the metal. The oxidized though comparatively bright surface of the steel plate is approximately equivalent to a fire and soot-dirtied copper plate. In addition, soot-dirtying a steel plate surface as it comes from the mill makes little difference in its heat-transmitting properties, while merely sooting a machined steel plate affects its rate of transmission very little. Experiments with tubes as well as with plates confirmed this deduction. The efficiency of steel and copper tubes was equal, but it seemed much greater than was estimated by Peclet. It also appears from these and the former experiments that the rate of transmission follows the square of the difference of the temperatures much more closely than Peclet thought. Mr. Blechynden's tables and diagrams are reproduced in the "Engineer."

The Production of Potable from Foul Water.

The particulars of the Mirlees, Watson, and Yaryan Company's apparatus for producing pure water from dirty or sea water were recently described in "Engineering." This is a "sextuple effect" appliance—that is to say, the heat derived from the steam boiler is used six times for evaporating in the evaporating and condensing apparatus. This does not represent all the effects which may be adopted in practice, since a larger number is possible. Beyond a certain point, however, the extra advantage obtained by increasing the number may not be worth the cost. The apparatus consists essentially of six cylindrical vessels containing heating and evaporating tubes, six separators corresponding to these vessels, and arranged in one vertical column, compound surface condensers and preliminary heaters, and the necessary circulating pumps. The condensed water is filtered and aërated; care being first taken to free it from the gases and air which it originally contained. It is conceivable that certain gas-works in hot countries and where clean water is scarce might make use of some such arrangement. According to results of trials made by the Egyptian Government, and the Perim Coal Company, the actual production of fresh water per pound of fuel consumed amounted to 33·9 lbs. and 35·7 lbs. respectively; the production of water being 31·8 tons and 61·8 tons per 24 hours. The initial steam pressure was about 88 lbs. per square inch.

A Vibration Meter.

Mr. John Milne, F.R.S., has constructed an instrument designed to measure the vibrations and jars experienced by metallic structures, such as bridges, which might perhaps be applied to record the stresses to which gasholders are subjected. The principles involved in the construction of these instruments are those embodied in a modern form of seismograph, in which although the frame of the apparatus may be subjected to rapid displacements, a certain portion remains practically at rest, and it is relating to the steady points in the system that the motion of the others is recorded. The instrument contains a clock carrying a roll of paper upon which any movement is recorded. At present the instrument, which is of a very compact form and strongly made, has been used to record irregularities in railway tracks revealed by the passage of trains in which it has been carried. The rapid vibrations caused by machinery in a building can also be measured in the same way; and the irregular action of reciprocating machinery of all kinds can be detected with a view to improved balancing. It is an interesting illustration of the possibility of adapting a scientific instrument originally intended for a special non-technical purpose to very precise practical uses.

The Perception of Light.

Discussing the phenomenon of the perception of light by the eye, Sir G. G. Stokes has remarked that, so far as relates to the formation of images on the retina, the eye simply acts like an optical instrument—like the objective of a telescope or microscope—and we may apply our mathematics to tracing the course of the rays through it. On the other hand, even if we knew accurately—which we do not—the nature of the effect which the external agent produces on the ultimate structure of our bodies, there would still remain, shrouded in impenetrable mystery, the nature of the process by which some change in the bodily organism causes a sensation to the conscious being. Sir G. G. Stokes thinks that possibly the outer member of the "rods and cones" of the retina may play the part of a microscopic electric battery, being charged somehow or another. In support of this suggestion, he referred to some remarkable experiments made several years ago by Professor Dewar and Mr. M'Kendrick, which went to show that an electrical change is effected in the dissected optic nerve by exposure to, and withdrawal from, light. There is another difficulty in the way of understanding the mechanism of the perception of light in the circumstance that the rapidity of the vibrations of light is far greater than the capacity which we can attribute to any organism to be set in vibration to a corresponding period. Thus it can hardly be imagined that the visual nerves are acted upon in this way directly by light, although they may, and indeed must, be affected by it indirectly.

A Modern American Power Station.

Some interesting particulars respecting American practice in designing steam-power generating stations for central town situations are given in a paper by Mr. H. W. York which appears in the February number of the "Proceedings" of the American Society of Civil Engineers. This paper describes the Twenty-Eighth Street central station of the United Electric Light and Power Company of New York—a concern formed by the combination of interests of the oldest companies in the field. The stations which the new Company acquired and attempted to operate had all been doing service for several years; and the apparatus was naturally somewhat antiquated. After making numerous changes and improvements in the old plant, there came a time when further patchwork was found to be impracticable; and Mr. York was instructed to replace them with a new station embodying all the latest improvements. It is not our intention to describe here precisely how he carried out these instructions, but to indicate the chief lines followed, and refer to the original those who need more detailed information. In the new station, economy of space has been so studied that engines indicating 20,000-horse power, together with the boilers, pumps, condensing apparatus, dynamos, and storage for 6000 tons of coal, are contained on a plot of ground measuring 160 ft. 11 in. by 197 ft. 6 in. The whole machinery, including the boilers, is on the ground floor; and yet there is plenty of light, air, and ample space for working round all the apparatus. The building is a steel-framed structure, with brick filling walls. The entire front wall is hollow, being really built of two walls—the outer 12 inches and the inner 8 inches thick—with a 2-inch air space between; and it is carried above the roof. Double windows are also employed with the object of preventing the noise of the machinery being heard outside. The foundations for the machines were kept away from the walls. Water-tube boilers, in 600-horse power units, Westinghouse double-acting engines, of the type known as the "Columbian steepled compound," and directly-coupled Westinghouse alternators, constitute the equipment. The coal-bunkers are immediately over the boilers, and have plate-iron bottoms inclined to the natural angle of repose of the coal, so as to completely discharge themselves.

TECHNICAL RECORD.

THE DEVELOPMENT OF THE GAS-ENGINE.

Before the members of the Gas Engineering Society, meeting last Wednesday (by permission of the Governors) in the Engineering Lecture Theatre of the Goldsmiths' Institute, New Cross, Mr. J. LINEHAM, M.Inst.M.E., delivered a lecture on "Gas-Engines." His experience as the Technical Instructor in the Engineering Section of the Institute enabled him to give to his lecture a comprehensive and succinct form; and although two hours were occupied in its delivery, the interest was well sustained to the end. Mr. C. TANNER, jun., presided.

The CHAIRMAN, in introducing the lecturer, gave a short outline of the various inventions which have led up to the present systems of gas-engine construction; but the principal facts which he related were subsequently covered in Mr. Lineham's lecture. He also stated that he had recently visited a few of the chief engineering works in Staffordshire. Among others, he inspected the works of Tangyes Limited; and the gas-engines he saw there were certainly most marvellous pieces of mechanism. What, however, struck him very forcibly as being a serious competitor to the gas-engine was a petroleum-engine, which was running in such a way that made him determine to be up and doing what he could for the further advantage of gas as a motive power.

Mr. LINEHAM, in his introductory remarks, said there is not much in the way of mechanical engineering in a gas-works. The business of gas manufacture comes largely within the province of what is known as civil engineering. There are, of course, some mechanical appliances in a gas-works—the now much-used stoking machines and the exhausters. The gas engineer, however, can get along very well without mixing himself up considerably with the subject of mechanical engineering. It is not even necessary that he should know anything about the construction of a gas-engine; but all would agree with him (the lecturer) that it is at least advisable that the gas engineer should have some such knowledge, though he need not investigate the subject at great length. Having explained the principle of the gas-engine, the lecturer said that all explosive engines come under the heading of internal combustion engines; and if carried out in their most perfect form, they ought to be far more efficient than any other class, because there is no heat loss by having to transmit the working fluid to considerable distances. After a few remarks on heat engines in general, he said he need scarcely tell members of the Society that in practice the high efficiency which is promised by theoretical calculation is never realized; but it must always be remembered that the heat of combustion is the real agent, and the gases are but the medium for the conversion of the energy. If all he had stated had been known at first, we might still have been very far from making a practical gas-engine—nay, perhaps farther; for it often happens that theory (spurious theory, he might say) tends to prevent the application of practice. The earliest attempts to make an internal combustion engine—long before coal gas was known—were confined to the use of gunpowder. The error of using such salts, he explained, is this: The atmosphere is rejected, and a salt adopted which contains the necessary oxygen for combustion—thus paying heavily for every particle of oxygen required, instead of taking it from the atmosphere at a cost of nothing. Last year Mr. Lineham had occasion to try, for an enthusiastic inventor, such an explosive engine—using oxygen-bearing salts; and he found it possible to get 1-horse power per hour at a cost of about 11s. or 12s., as against 1d. with the gas-engine.

In 1791, John Barber made the first actual gas-engine; but as coal distillation on a large scale had not then been discovered, Barber had to distil his gas from wood, &c., in a small retort. In 1794, Street made gas in a motive engine by sprinkling turpentine or petroleum on a hot plate; and he obtained ignition by external flame. In 1800, Lebon proposed to use coal gas; but he was assassinated in 1804. Between 1823 and 1826, Brown had engines actually at work in London; his being the principle of partial vacuum. Newcomen produced an engine—the first important steam-engine—on the same principle; and, in fact, the gas-engine seems to have gone through the same stages as the steam-engine in the past. Gas engineers are by no means learning lessons by looking at the steam-engine; they are having to learn them by paying for them separately themselves. In 1833, Wright proposed an engine with slight compression before admission, and governor regulation—varying speed by varying the proportions of gas and air. In 1838, an important advance was effected by Barnett. He made an engine which worked very satisfactorily considering the time. He had compression after admission, and a very satisfactory revolving ignition cock. In referring to a diagram of this ignitor, Mr. Lineham remarked that the same principle was applied by Crossley at a later date. Between 1838 and 1860, a large number of patents were taken out; but there was the difficulty of procuring lighting gas, excepting in a few large towns. The honour of having made the first practical working gas-engine belongs to Lenoir. Barnett's was the first working engine of which notice could be taken; Lenoir's was the first that could be put on the market, and made in any quantity. Mr. Bryan Donkin, writing on this subject, said that everybody was eager to use this engine. The economy attributed to it, exaggerated by report, increased its popularity. The new motor was credited with an economy of gas which inventors, after thirty years' study and experience, had hardly been able to realize. So great was the demand that, in five years, between 300 and 400 were made in France and 100 in England. Exaggeration killed the engine, together with its faults; and the gas-engine was abandoned once more. By aid of diagrams, Mr. Lineham described Lenoir's engine and its faults. Its consumption of gas was from 88 to 105 cubic feet per horse power per hour. This extravagant consumption, Lenoir thought, was due to the sudden explosion, and also to the lack of stratification. This latter is a point (remarked the lecturer) on which there was a great deal of discussion right up to the time when the Otto engine was produced. It seems strange, after what was known of gases intermingling, that inventors could believe that gas and air could remain in separate streams. If they could be so kept, explosion could be retarded. A gradual explosion will give more work, a better sustained pressure curve, less shock to the engine, and consequently a thinner cylinder can be employed.

Proceeding with his historical sketch, Mr. Lineham said that Hugon, who was a Director of the Paris Gas Company, tried to improve on the Lenoir engine, and took out a patent in 1858. But the principles involved were just the same, and the indicator diagram similar. The engine was as wasteful as the Lenoir; the gas consumption being 77 to 92 cubic feet per horse power per hour. In 1866, the Otto and Langen vertical engine was patented; and although we do not agree with the principles of this engine at the present time, it was the first which could be put upon the market as a fairly economical engine. About 5000 of these engines were made in ten years. The consumption of gas was reduced to 26 cubic feet per horse power per hour; this economy being due to somewhat better expansion. In describing the details of the engine, the lecturer observed that, by turning back to the patent of Barsanti and Mattenci—1854-7—it would be seen that it is the same as the Otto and Langen; but it was never in the market. In 1862, a very important patent was taken out in France, which was unnoticed at the time, because it was theoretical and descriptive; but it is the absolute basis of all the best gas-engine practice of the present day. The patentee was Beau de Rochas; but he obtained nothing from it, excepting a prize from the French Government after the gas-engine became an accomplished fact. He laid down four conditions for maximum efficiency: (1) Largest cylinder volume, with the smallest circumferential area; (2) maximum speed of piston; (3) greatest possible expansion; and (4) highest pressure at the beginning of explosion. The last point is the *crux* of the whole question. Rochas believed it necessary to use one cylinder only, and proposed the cycle which has since been wrongly called the Otto cycle. He wished to so compress the charge that the heat of compression would ignite at the dead-point; but this has since been found impracticable. In all inventions, there are, said Mr. Lineham, three stages: (1) To find what is needed; (2) to demonstrate in a theoretical manner how this might be done; and (3) to apply "2" so as to make a marketable machine. The early inventors had shown "1;" Beau de Rochas "2;" and Otto came on the scene in 1876 to show how "3" might be accomplished. Otto proposed two principal things: (1) Stratification to reduce shock—a thing not now believed in; and (2) to carry out the Beau de Rochas cycle in its entirety, though, he (the lecturer) was sorry to say he said nothing of Beau de Rochas himself. Pointing to a diagram, it would be noticed, said the lecturer, that Otto had not then a clear conception of the great advantage of compression as producing a higher initial pressure and better opportunity for sustaining expansion.

In a paper read by Mr. Crossley in 1875, he argued that the Otto-Langen principle was the only correct one; but to the surprise of everybody it was thrown over for the Otto-Crossley engine in the following year. This new engine was shown at the Paris Exhibition in 1878, and success was recognized from the beginning. At some length, Mr. Lineham described the general arrangement of the engine; and afterwards he stated that the consumption of gas was 17 to 25 cubic feet per horse power per hour. If coal was used to make poor gas, 1·1 lbs. to 1·4 lbs. of anthracite would be consumed per indicated horse power, or equal to the very best steam-engine—¼d., as against ¾d. by ordinary gas. Referring to other engines of the Otto type, the lecturer directed attention to the "Simplex," which, he said, has been to the front with very large powers. Some four years ago, he heard of one of 350 brake horse power with single cylinder; but since then Messrs. Crossley have made double-cylinder engines of 600 and 700 brake horse power. However, the makers of the 'Simplex" were the first to introduce engines of these large powers.

Engines working on cycles distinct from those used by Otto next claimed the attention of the lecturer—the first to be dealt with being Atkinson's. Two separate engines were designed by this inventor—the "Differential" and the "Cycle"—in 1885 and 1886. In both of these, he sought to obtain a higher efficiency than in the Otto cycle by making the expansion and exhaust stroke occupy a longer time than the admission and compression strokes. The whole cycle of operations was completed during one revolution of the crank. The "Differential"

was soon discarded by Atkinson for the "Cycle," the consumption of which was 19·22 cubic feet of gas per indicated horse power, and 22·5 cubic feet per brake horse power. While Otto obtained an expansion of 2½, Atkinson expanded his gas 3¾. The Atkinson cycle was characterized by Mr. Lineham as "a distorted Beau de Rochas."

Other engines of different types could only be noticed in a cursory manner. Dugald Clerk's engine was first described; and then the Beck engine, in which a six-stroke, instead of a four-stroke, cycle is used. The "Griffin" engine was represented as being very steady for electric lighting. Among small-sized engines, the Dawson and those made by Messrs. Day and Co., of Bath, received attention.

Comparing the relative economy of various systems of motive power, Mr. Lineham stated that electricity from a company would cost about 4½d. per horse power; steam, ¼d. and less (that was the cost of coal, not anything else); Dowson or water gas, ¼d. and less (competing directly with steam); lighting gas, ¾d.; and petroleum, ¾d. It would, he remarked, be idle to say that the petroleum engine is not a formidable rival of the gas-engine. Priestman made the petroleum engine a success eight years ago. Yet gas-engines may remain in undisturbed possession where a supply of gas can be procured easily and cheaply. There were more parts about a petroleum engine; and they consequently cost more. It is to the benefit of all, observed the lecturer in conclusion, that we have such a choice of power in these various systems, each of which will have its place.

Mr. Lineham was heartily thanked for his interesting lecture, on the proposition of the CHAIRMAN, seconded by Mr. E. D. WEIPPERT, the Secretary of the Society.

REGISTER OF PATENTS.

Production of Acetylene Gas, and Utilizing Same for Lighting Purposes.—Ragot, G., of Forest-lez-Bruxelles, Belgium. No. 5279; March 9, 1896.

This invention has for its object the production of acetylene gas from the hydration of calcium carbide; the whole system consisting "in the mode of, and apparatus for, producing the gas in combination with the means employed for burning it, so as to secure the maximum of lighting power therefrom."

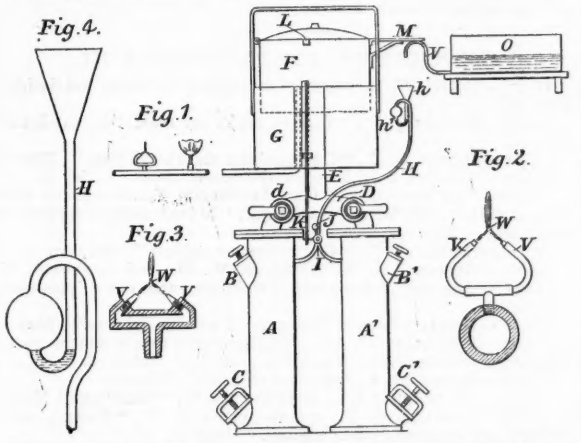


Fig. 1 represents an apparatus for automatically producing the gas, surmounted by a holder or reservoir acting automatically; the pipe being provided with two burners. Fig. 2 is a front view of a burner. Fig. 3 is a vertical section of a modified form of burner, operating like that shown in Fig. 2. Fig. 4 is an enlarged view of the tube used for introducing water into the apparatus for producing gas.

A A^1 are two cylindrical reservoirs, provided with openings having tight-fitting covers B B^1 above, and openings with covers C C^1 at the bottom. These reservoirs are connected with each other by a pipe D, in which are arranged two cocks designed to open and close the passage for the gas leaving one of the reservoirs A or A^1 at will. E is a pipe connected to the pipe D, for conducting the gas to the holder F arranged in the cylinder G. H is a tube for conducting water, which it receives from a reservoir O, into one or the other of the reservoirs. After the two reservoirs have been filled with a charge of calcium carbide (the latter being introduced therein through the openings or passages at B B^1), water is admitted to the reservoir by means of a tube H, divided into two branches at its extremity; the two branches terminating each in one of the reservoirs A A^1. The bifurcating point of this tube H is furnished with a cock I, designed to allow the water to pass either into A or A^1, according as it is turned to the right or left. To the cock is secured, at right angles, a counter-weight J, which, with the cock, is actuated by a rod K, having a pawl and sliding along the holder. The rod carries at its upper part a spring-arm, against which butts the tappet L, which forms a projection on the holder crown.

The admission of water into the pipe H takes place automatically. The upper part of the holder carries a bracket M, at the end of which is fixed the extremity of a flexible tube N, connected with a water reservoir O. When the bell descends, it carries with it the flexible pipe, so that, when the latter is below the level of the water in the reservoir O, the water will flow into the funnel through the tube H into the reservoir A or A^1. When, however, the holder moves upward, the flow of water will be interrupted. Fig. 4 shows the pipe H and funnel to a larger scale. It is furnished with a bulb, and with a bend containing a small quantity of mercury. When the pressure due to the height of the column of water in the pipe H is greater than the resistance of the mercury, the water will flow through the bulb until equilibrium is established between the pressure of water and that of the mercury. This arrangement (says the patentee) is very important, because, owing to the great hygroscopic property of the calcium carbide, any water present (even at some distance from this body) will give rise to a considerable disengagement of gas, which, if not utilized, would escape through the hydraulic joint of the holder.

In operation, the apparatus acts thus: The holder being in its lowest position, the flexible tube N allows water to escape into the tunnel and tube H, from which it passes into one of the cylinders A or A^1, containing the calcium carbide, which it decomposes into acetylene. The pressure of the gas formed raises the holder F, which, by lifting the flexible tube N, by reason of its connection at M, interrupts the intermixing of the water, and thus also the production of the gas. Of course, if a certain quantity of gas is allowed to escape from the holder, the tube N will be moved downwards, and permit of the outflow of a fresh quantity of water into the reservoir A or A^1. Accordingly the production will be regulated automatically in direct proportion to the amount used. When nearly the whole of the gas has been withdrawn from the holder, and the latter (owing to the exhaustion of the carbide in one of the reservoirs) has moved down, the tappet L will butt against the pawl of the rod K, which will actuate the two-way cock I, and cause the water to be distributed into the other reservoir, thus giving rise to the production of gas without any stoppage.

The acetylene passing through the pipe from the holder is conducted directly to the burners, types of which are represented in figs. 2 and 3. This burner consists of two parts V V, converging towards each other at a suitable angle. As the gas-jets encounter each other, they become mingled; and, being united, they produce a flame burning vertically at the point W. By their discharge under pressure, they "carry away the air necessary for the production of the lighting flame, which burns with a very strong light, having a greater lighting power than any light heretofore produced by gas." Alluding further to his burner, the patentee says: "Looking at the improved burner in a superficial manner, it may be erroneously concluded that it is the same as the well-known Bray burner, termed 'Manchester burner.' This would be a serious mistake; for the effects which I achieve by the arrangement of my new burner are quite different from those obtained by the Manchester burner. In fact, the latter consists of a burner-tube presenting exteriorly the same arrangement as an ordinary butterfly burner; but the slit for the escape of the gas is replaced therein by two small convergent orifices, approaching each other at their top to a distance of about 1 millimetre. In my burner, the space left between the two outlet-orifices of the convergent tubes is from 2½ to 3 centimetres; so that the flame of each of them traverses a considerable air-space, and, combining therewith, cause by their contact a butterfly flame, suspended, as it were, in the air, which consequently surrounds it on every side—that is to say, as regards combustion it is in the best condition which it is possible to obtain. In my burner, there is a double displacement of air; and if ordinary lighting gas is caused to pass through the same, it burns with a blue flame exactly as is the case with bunsen burners, which proves that the displacement of air is very great (I may even add that it reaches its maximum effect) at the same time that an intimate mixing of air and gas takes place at the junction of the two jets."

Generating Acetylene Gas.—Turney, E. T., of Chicago, U.S.A. No. 5375; March 10, 1896. Date claimed under section 103 of the Patents Act, Feb. 1, 1896—being the date of the United States application.

This invention relates to apparatus for the production of acetylene gas from calcium carbide in portable apparatus, such as could be attached to bicycles and other light vehicles, and the gas used in the lamps of same.

One of the objects of the invention is to generate the gas in only the limited quantity needed for immediate consumption, and to keep the quantity generated practically constant throughout the process of generation. Another object is to use the gas directly after it is generated, and at substantially the pressure at which it is produced. The first of these objects is accomplished by exposing a portion of the surface of a cartridge containing a solid ingredient of the gas-generating compound, in the form of a compact body of uniform sectional area to a liquid ingredient, and protecting the remainder of the surface in such manner that the area of the exposed portion, and consequently the quantity of gas generated, are kept practically constant. The liquid ingredient preferred for use is a solution of methyl alcohol (one part) and water (nine parts), to which the calcium carbide or other metallic carbide is gradually added in just sufficient quantity to produce the amount of gas needed for immediate use. The calcium liberates hydrogen from the water; and the hydrogen combines with the carbon and forms acetylene gas. Without the alcohol, this chemical combination would be very rapid; and it is simply to retard it that the alcohol is used.

Gas-Meters.—Hour, C., of Paris. No. 5268; March 12, 1895.

The object of this invention is to enable hotels, or similar establishments, to retail to their customers such quantities of gas as they require, more particularly to feed heating apparatus; and the invention further affords such gas retailers reliable means of checking the supplies of gas, while it permits the consumers to make sure that they only pay for the amount they have actually used—leaving them the option of extending the consumption of a given quantity over any convenient period of time, they being at liberty to turn on, cut off, or control the supply at pleasure.

The apparatus mainly consists of a cock or controllable valve, inserted in the gas-pipe, and suitably combined with clockwork, or with a main spring enclosed in its barrel or case. The characteristic feature of the relation existing between the gas-cock and the clockwork mainly resides in the interposition of a pendulum, adapted to regulate the

operation of the clockwork, and also in the direct proportion or ratio (maintained by accessory mechanism) between the gas supply and the motion of the pendulum. While the cock is closed, the pendulum remains at rest; whereas, whenever any gas is passing—no matter through which port or aperture of such cock—the pendulum will be set in motion. On the other hand, the variable gas supply through the cock is made to correspond to the variable length of the pendulum, in such a manner that a short length of pendulum corresponds to a wide opening of the cock; and, consequently, the wider the opening, the greater the speed of the clockwork.

The meter, the essential features of which have been thus defined, may be modified by making the aperture of the cock or valve constant, so that it corresponds to an equally constant length of pendulum. The "closed" position of the cock corresponds to the position of rest of the pendulum; while the "open" position corresponds to a pendulum motion at a constant speed.

Where a pendulum is employed, the length of which is capable of variation—*i.e.*, where the gas supply is required to be variable—the apparatus is set in motion by fully opening the cock. This, however, is only feasible after having previously inserted into the meter-case a predetermined coin, the value of which represents that of the gas which the meter, thus set in operation, will admit of being utilized, before a fresh coin is inserted. Having once set the apparatus going, its supply may be controlled at will by operating a lever which actuates the cock. But to whatever extent the cock may be opened, the resulting aperture will proportionally determine the length of the pendulum which regulates the clockwork, and also, consequently, the speed of motion of the index-hands operated by the clockwork. The dial whereon each hand moves will accordingly at all times indicate what amount of gas represented by the coin has, till then, been consumed, and how much remains to be consumed to exhaust the sum paid.

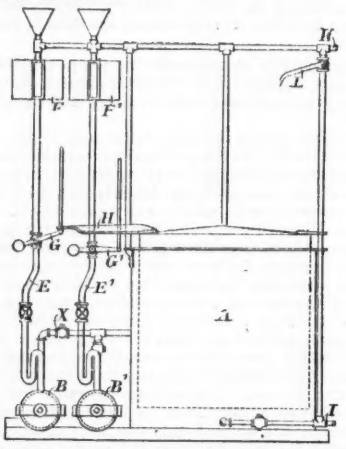
Where, on the other hand, a pendulum is used, the length of which does not vary (such as a circular spiral spring balance), or, in other words, where the supply of gas need not be variable, the apparatus is also set in operation by opening the gas-cock by hand, which ensures the movement of the clockwork; and the quantity of gas used then becomes proportional to the time spent. Instead of having a graduation in quantities, there is a graduation in hours; the dial on which the hands move being divided into 24 equal parts, each corresponding to one hour's supply. In order to enable the apparatus to furnish gas, unchecked, for several periods of 24 hours, there is added to the "hour" meter, a "time totalizer," designed to indicate for how many periods of 24 hours each the gas supply has lasted. By adding to the number of hours thus recorded the number of hours marked off on the hour-dial by the index-hands, the total length of time during which the apparatus has been supplying gas is shown.

Draught Protectors for Incandescent Gas-Burners.—Wright, W., and Reed, J. P., of Plymouth. No. 5449; March 15, 1895.

The proposal of the patentees is to take a piece of metal, and make it into a suitable shape to fit on the burner below the mantle, allowing sufficient space for the chimney to pass over. The metal protects the mantle from an upward draught of air; and thereby is said to improve "the durability of the mantle, with better results in regard to light and the mantle."

Generating Acetylene Gas.—Clarke, W. C., of New York, U.S.A. No. 7243; April 2, 1896.

This invention is more especially intended to be used in connection with the production of acetylene gas by the mutual decomposition of water and carbide of calcium.



A form of apparatus for carrying the invention into effect is shown. A is an expansible gasholder; and B, a cylinder adapted to receive a charge of carbide, preferably contained in a removable cartridge or vessel. One end of B is adapted to be opened for the insertion and removal of such vessel, and is closed with a gas-tight cap firmly secured by a swinging yoke and set-screw. The chamber B is connected to a pipe D, leading to the holder. Between the holder and the chamber B is an automatic check-valve, which closes toward the chamber. From the chamber, a pipe E leads to a water-tank F, placed above it. In the pipe is a trap, or water-seal, to prevent the escape of gas from the chamber through the pipe, and a valve, to the stem of which is attached a weighted arm G, which is so balanced that normally the valve is kept closed. The arm projects towards the holder, and is adapted to be brought in contact by the falling movement of the holder as gas is drawn therefrom, with an arm H attached to the holder. Thus when the holder is down, or, by reason of the consumption of gas, descends to a point where the arm H comes in contact with the arm G, the latter is pressed down; and the valve opened. But when the holder is lifted by the admission of gas to it, so that the arm H is no longer in contact with the arm G, the latter rises; and the valve is closed. From the holder, a delivery-pipe I leads to the burners. In order to prevent the accidental over-charging of the holder with gas, a pipe K connected with the holder discharges into the open air, and is normally closed by a valve, to which is connected a weighted arm L. When the holder is forced by an excess of gas above its normal maximum elevation, it comes in contact with the arm L, lifting it and opening the valve; so that the excess of gas is discharged until the holder settles and falls away from the arm L, when the valve is again closed.

The method of operation is as follows: Beginning when there is no gas in the holder A, the generating chamber is charged with a quantity of carbide of calcium. Preferably the size of the charge, in relation to the size of the generating chamber, is such that, when it is fully decomposed, the solid products of decomposition will substantially fill the generating chamber, so that all the gas produced will be forced out, and into the holder. A small quantity of water is then poured into the tank F, and passes down into the generating chamber, causing the decomposition of a corresponding amount of the carbide. The resulting discharge of gas passes through the pipe D, into the holder, filling and lifting it. The arm G is then set free; and the end of it nearest to the holder rises, closing the valve. Such quantity of water as is requisite to effect the decomposition of the entire charge of carbide in the generating chamber is then placed in the tank F. As gas is drawn from the holder, it settles until the arm H comes in contact with the arm G, which is pressed down, so as to open the valve, and a small quantity of water trickles down the pipe E into the generating chamber, causing the generation of a fresh quantity of gas, by which the holder is again lifted—the valve being once more closed. This operation is automatically repeated until all of the carbide in the generating chamber has been decomposed.

In order to enable the supply of gas to be kept up without interruption, while the chamber B is being re-charged with carbide, an additional generating chamber B^1 is employed, which is also connected to the pipe B, leading to the gasholder. It is provided with a water-supplying arrangement similar to that described in connection with the chamber B. In this case, the arm G^1 is set at such a level that the charge in B^1 will not be called into operation until after that in the chamber B is fully exhausted, and the holder sinks to a lower level than that at which it is when the arm H comes in contact with the arm G. When it appears, on inspection, that the generator B^1 is in operation, the chamber B can be opened, the products of decomposition removed, and a fresh charge inserted, without interfering with the supply of gas to the holder. The escape of gas when the chamber B is open is prevented by the check-valve X, which is closed by the gas pressure from within the holder.

APPLICATIONS FOR LETTERS PATENT.

11,373.—Ward, W. J., "Bracket or support for lamps and the like." May 26.

11,385.—Rogers, J. E., "Taps or cocks for regulating gas-lights." May 26.

11,411.—Ostins, G. F., "Gas pendants and chandeliers." May 26.

11,433.—Siemens, F., "Regenerative gas-furnaces." May 26.

11,530.—The Economical Gas Apparatus Construction Company, Limited, and Merrifield, L. L., "Manufacture of carburetted water gas." May 27.

11,546.—Horsey, J. G., "Gas or vapour engines." May 27.

11,566.—Gritton, H. B., Edwards, W. H., and Sheridan, W., "Lamp globes for illumination, decorative, and other purposes." May 27.

11,581.—Moreau, G., and Poulhies, A., "Gas-lighting." May 27.

11,602.—Bruxelles —, sen., "Attachments to gas-meters with a view to preventing certain fraudulent practices." May 28.

11,621.—Maxim, H., "Separation of gases." May 28.

11,632.—Goldschmid, J. E., and Dellwik, C., "Water gas." May 28.

11,656.—Lamplough, F., and Goodman, F. T., "Pumps, water-meters, and steam and other engines." May 28.

11,696.—Glover, R. T., & J. G., "Coin-freed gas-meters." May 29.

11,706.—Bauweraerts, E. F. J. C., "Purifying acetylene gas." May 29.

11,707.—Bauweraerts, E. F. J. C., "Burner for acetylene gas." May 29.

11,708.—Bauweraerts, E. F. J. C., "Generation of acetylene gas." May 29.

11,737.—Clausolles, E., "Production and storage of acetylene gas for illuminating purposes." May 29.

11,768.—Clayton, R., "Doors of gas cooking-stoves." May 30.

11,809.—Thompson, W. P., "Lighting railway carriages and the like." A communication from A. Dempster. May 30.

East Surrey Water Bill.—The Reigate Town Council have suddenly woke up to the fact that they have some interest at stake in the provisions of the Bill intituled: "A Bill to authorize the transfer of certain water-works to the East Surrey Water Company, and to extend the limits of supply of, and confer further powers on, that Company; and for other purposes." The Mayor complains that the Council have not had a copy of the Bill sent to them, though strangely enough the Town Clerk (Dr. Greece) is a Director of the Company, who, under the Bill, propose to absorb the undertaking of the Reigate Water Company. It further appears that the first intimation that most of the members of the Council received of the existence of the Bill was from a letter written by Lady Henry Somerset, the principal property owner in the town, who urged the Corporation to oppose the Bill, in order that the Reigate works might be municipalized. At the eleventh hour, so to speak, the Council have resolved to oppose the Bill and to employ a solicitor other than the Town Clerk to carry out the necessary proceedings; and in the meantime it has also been resolved to ask the member for the division to delay the progress of the Bill until the facts are placed before Parliament.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

Preventing the Freezing of Gasholder Cups, &c.

SIR,—We notice in the last issue of the "JOURNAL" a very interesting article, entitled "Fighting the Frost," written by Mr. Norton H. Humphrys in his usual attractive style. Having regard, however, to what is said therein, as to preventing the formation of ice in gasholder cups, &c., will you allow us to call attention to what we ourselves have done in this way, as we believe we are right in saying that we were the first to practically apply a satisfactory arrangement for conveying steam to the cups of the lofty gasholders now so commonly erected. Our devices have been freely advertised in your columns during several winters past, and have figured in our catalogues since 1891. They have been applied to some scores of gasholders, including the large ones at Beckton, Kensal Green, Bethnal Green, Vienna, Berlin, Hanover, Frankfort, Copenhagen, and Amsterdam, and also to several in the United States of America. We believe our patented system of conveying the steam in flexible tubes carried on counterpoised pulleys is the only satisfactory one for holders rising to any considerable height.

S. CUTLER AND SONS.

Millwall, E., June 13, 1896.

SIR,—Upon reading Mr. Norton H. Humphrys' article in your issue of the 9th inst., it appeared to me that there was no novelty in the plan for thawing gasholder lutes, &c., except the cost of the elaboration. Instead of using aspirators or injectors, why not use the steam-pipe pure and simple—say, $\frac{3}{8}$ or $\frac{1}{2}$ inch tapered down to a $\frac{1}{4}$-inch nozzle, fixed precisely in the way described for the injector? The results would be equally good, with the merit of being less costly and complicated. The writer adopted the plain steam-pipe for a holder of the dimensions mentioned 15 years ago, conveying the steam for upwards of 200 yards (picking up the purifiers, &c., on the way); and it has answered all possible expectations—the circulation being very rapid.

H. TAPLAY.

Wellington (Salop), June 13, 1896.

Professor Lewes on the Value of the Sunlight Mantle.

SIR,—I ask your permission to draw attention to the following passage in the paper read by Professor Vivian B. Lewes before the Incorporated Institution of Gas Engineers, and reported in your issue of the 19th ult.:—

> So far, every point seems in favour of the plebeian Sunlight. The chemicals used in its manufacture cost but a small fraction of a penny, instead of 6d., and are unlimited in quantity. The strength of the mantle is so great that only accident or violent shock breaks it; and when cold it can be handled with ordinary care, while the light emitted is but a little below that given by the Welsbach. The only remaining question is as to the light-emitting life of the mantle; and I regret to say that, owing to the shortness of time that they have been in my possession, I am unable to speak personally as to this point. From theoretical considerations, I should expect the light to diminish more rapidly than with the thoria mantles. But the strength of the alumina mantle preventing any very great loss of surface from the skin-friction of the burning gas, the illuminating power can be revived by blowing off any clinging dust, and re-spraying with a chromium salt by means of a lady's spray-bottle.

This paragraph is so surprising that I fully expected to see some explanation or correction in a later issue of your "JOURNAL;" but none being forthcoming, I must ask leave to offer a few criticisms.

Professor Lewes has every advantage in discussing the relative merits of the Welsbach and Sunlight systems. He has been for a year engaged in examining and experimenting upon both; he is a chemist of proved ability and of great experience; and he has devoted special attention to gas appliances. Professor Lewes has so high a reputation, that it is impossible to accuse him of either *suggestio falsi* or *suppressio veri*; but the passage above quoted seems to have been worded with the express intention of inviting suspicion.

Does Professor Lewes seriously contend that he does not know the rate of decrease of the lighting power of a Sunlight mantle? And, if so, has he taken any trouble to satisfy himself on this point; or is he of opinion that "Where ignorance is bliss, 'tis folly to be wise?" Professor Lewes attributes his ignorance on this point to the short time the mantles have been in his possession. Would he be surprised to hear that a period of 40 hours is sufficient to show a greater proportionate decrease in the light of a Sunlight mantle than he attributes to a Welsbach mantle in 1000 hours? Would he be surprised to hear that, after 70 hours, the Sunlight mantle is practically useless? Surely, having been retained by the Sunlight Company for over a year, he might have found time to test a Sunlight mantle for 40 to 100 hours, the more so as he has evidently tested the Welsbach mantle for 1000 hours.

As soon as we read Professor Lewes's paper, and in order to further convince ourselves on the point, we sent to the Sunlight Company's showrooms and purchased two dozen Sunlight mantles, after which we again sent to the Sunlight Company's showrooms, and asked for three of the very best mantles they could supply to us, and these were handed to us as the best they could produce. I may state that these three particular mantles were in all respects identical with the two dozen previously purchased. Half of the mantles thus obtained, we still retain in our possession; the other half were tested on the Sunlight Company's own burners, duly regulated at a pressure of a little over 1 inch. They gave uniformly 45 to 46 candle power at the start; after 30 hours, the loss was 25 per cent. of the initial lighting power; after 50 hours, the loss was 50 per cent.; while after 70 hours, the mantles were practically useless.

But Professor Lewes is full of startling surprises. He asserts that very little loss of surface results from exposing Sunlight mantles to a gas-flame. I would ask him whether he has seen a Sunlight mantle after 40 hours' use; whether the shrinkage is not very considerable; and whether the mantle is not so attenuated as to make it practically useless, even when re-sprayed "with a chromium salt by means of a lady's spray-bottle."

As a chemist, is not Professor Lewes aware that alumina and chromium rapidly volatilize in a bunsen flame? And can he reconcile this well-known physical property of those earths with his statement that "the strength of the alumina mantle preventing any very great loss of surface from the skin-friction of the burning gas," &c.?

Will Professor Lewes undertake to prove that a Sunlight mantle, starting (say) with 45 candles, will give as much as 15 candles after 100 hours' burning? And, if so, will he submit one dozen such mantles to a public test, six of such mantles to be submitted for analysis, and the remaining six for photometric test? The results of tests made for us of Sunlight mantles show that 70 hours is the limit of their utility; and even then they do not give more light than an ordinary flat-flame burner. That is to say, one Welsbach mantle, costing 1s. 3d., outlives ten Sunlight mantles, so that the latter would be dear at $1\frac{1}{2}$d. each.

Professor Lewes, as an expert witness for the Sunlight Company, naturally makes the best case he can for the Sunlight mantle. But when he reads a paper on "Incandescent Gas Lighting" at a scientific meeting, one looks for scientific accuracy, and not for partisan advocacy; and it is to be regretted that one looks in vain.

JULIUS MOELLER, General Manager,
Incandescent Gas-Light Company, Limited.

14, *Palmer Street, Westminster, S.W., June* 12, 1896.

New Water-Works at Brighton.—The new pumping plant at the Patcham station of the Brighton Water-Works is now completed and in working order. The plant consists of one triple-expansion marine engine, service condenser, one set of three-throw pumps, one pair of deep-well pumps and rising mains, barring engine, two Lancashire boilers, and a 12-ton travelling crane. The engine, which is in every respect of the type now used on all large ships, was designed by Mr. James Johnston, the Water Engineer to the Brighton Corporation; and it is built to lift from the bottom of the well into the highest reservoir on Race Hill, which is $4\frac{1}{4}$ miles away—a total height, exclusive of friction on the main, of about 460 feet. The lifting capacity is 3 million gallons of water per diem; but under ordinary circumstances, the plant will only be worked about 12 hours per day. The Corporation will now be able to work at extending the headings for a longer period at a time than hitherto; and it is hoped to increase the present available quantity of a million gallons per day in the dry season to 2 million gallons per day. At the present time there are about 1700 feet of headings excavated at a depth of 175 feet below the ground, besides two pumping-wells and two winding-shafts. The contract for the new plant was £10,350, which together with £2897, the cost of the buildings, and about £1500 expended on the well and engine foundations, makes a total outlay of upwards of £17,700. The engine was started on the afternoon of the 6th inst.

Water Supplies in Cornwall.—Owing to the recent drought, attention has once more been directed to the inadequacy of the water supply in many parts of Cornwall. At Boscastle, the new supply provided last year is already reported to be quite inadequate to the requirements of the place. Whether this is due to failure of the source of supply or to a mistake in the estimate, is not clear. It is said, however, that the quantity is not one-fourth of that originally estimated by the engineer who carried out the works. The Camelford District Council have decided to extend the supply. The same authority have had under consideration a proposal for increasing the water supply of Tintagel, but have postponed the discussion of it because no direct complaints have reached them from the inhabitants. In connection with the supply of the town of Bude, the Stratton District Council are halting between two schemes; but they are likely to be stirred to action by a threat from the Local Government Board to declare the Council in default. At St. Day, the inhabitants are memorializing the Local Government Board on the subject of the water supply. The district has long suffered from the want of water; and the opinion is expressed that a determined effort should now be made to provide for its requirements. A meeting has also been held at Perranforth to consider the question of the supply of that district. Several schemes are suggested; and a Committee has been appointed to investigate them, and report to a future meeting upon their cost and suitability. In several other parts of the county, the want of an efficient supply is keenly felt; but the depressed condition of the mining industry is a bar to any movement for providing a remedy.

New Reservoir for Morley.—The ceremony of cutting the first sod of a new service reservoir has just taken place at Morley. Previous to 1894, the borough obtained its water supply from Leeds; but the great cost and the increased consumption during recent years led the Morley Town Council to embark on a scheme of their own. Parliamentary powers were obtained in 1890; and in 1894, the water-works were opened. The supply is derived from a reservoir at Withens Clough, near Mytholmroyd, which collects the water from the surrounding moors, 21 miles from the town of Morley. That reservoir has a storage capacity of 330 million gallons, and is at an elevation of 960 feet above sea level. From this reservoir, the water is conveyed in iron pipes through 13 towns and villages to Morley. The object of the new reservoir is to intercept the water intended for the higher portions of the town, so that, should the supply from the storage reservoir be temporarily cut off, either by accident or with a view to effecting repairs, the town would not be without water. The service reservoir will also act as a settling-tank whenever the water obtained from the moors is turbid; and, if necessary, the supply from the storage reservoir can be cut off for a short period under such circumstances, and the town supplied with clean water from the service reservoir. This reservoir will be about 330 feet long and 300 feet wide, and will have a water surface of about $2\frac{1}{4}$ acres. The depth will be about 20 feet, and the capacity 10 million gallons, or more than sufficient for a week's supply. The basin will be constructed by excavating to a depth of 7 feet, and constructing around the excavation an embankment of the material thus obtained. The bottom of the reservoir will be lined with clay puddle; and the core of the embankment will be formed of the same material, in order to render the basin water-tight. The whole of the inside of the reservoir will be covered with a paving of stone. In adopting this method of construction, the Engineer (Mr. C. Gott, M.Inst.C.E., of Bradford) has had in view the necessity for providing against any subsidence of the ground owing to the many coal workings in the neighbourhood.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Tuesday, June 9.

METROPOLITAN COUNTIES WATER BOARD BILL.

This Bill came before the Standing Committee of the House to-day, under the presidency of Lord Herschell. Lord James of Hereford moved the addition of the following words to clause 8 ("Power of County Council to apply to Withdraw from Water Board"): "Whereas it is intended that, save as regards the Metropolitan Water Companies, nothing in this Act should affect any existing right or power of any company or body supplying water to any part of the Metropolitan Water Area; and whereas it may hereafter be found beneficial to vest in the Council of any Metropolitan county the power to supply water to that county, be it enacted," &c. The amendment was agreed to. After other verbal amendments had been accepted, the Bill was reported to the House.

The following progress was made with Bills last week:—

Bills read the first time and referred to the Examiners; Chelsea Water Bill, Eastbourne Water Bill, Gas Provisional Orders Bill, Lambeth Water Bill, Portsmouth Borough Water Bill.

Bills read a second time and committed: Bournemouth Gas and Water Bill, Kirkcaldy and Dysart Water Bill, Sheffield Corporation Water Bill.

Bill referred to a Select Committee, consisting of Earl Northbrook (Chairman), Lord Clifford of Chudleigh, Lord Dunalley, Lord Chelmsford, and Lord Monck; to meet on June 16: Matlock Bath Gas Bill.

Bill reported, with amendments: Metropolitan Counties Water Board Bill.

Bills read the third time and passed: Aldershot Gas and Water Bill, Bonnybridge, &c., Water Provisional Order Bill, Redheugh Bridge Bill.

A petition in favour of the Metropolitan Counties Water Board Bill was presented from St. Pancras.

Petitions were presented against the London Sea Water Supply Bill and the Sheffield Corporation Water Bill.

HOUSE OF COMMONS.

The following progress was made with Bills last week:—

Bill read the first time: Kilmarnock Corporation Water Bill.

Bills read the first time and referred to the Examiners: Aldershot Gas and Water Bill, Dalmeny and Kirkliston Water Provisional Order Bill, Redheugh Bridge Bill.

Bills read a second time and committed: Drogheda Corporation Bill, East Surrey Water Bill, Kelty Water Provisional Order Bill, Manchester Corporation Bill, Newcastle-upon-Tyne and Gateshead Gas Bill.

Bills reported: Falkirk and District Water Bill, Padiham Urban District Council Water (Extension of Time) Bill, Yeovil Corporation Water Bill.

Bills read the third time and passed: Eastbourne Water Bill, Gas Provisional Orders Bill, Portsmouth Borough Water Bill.

HOUSE OF COMMONS COMMITTEE ON THE LONDON WATER BILLS.

Thursday, June 4.

(*Before Sir* J. PEASE, *Chairman; Sir* J. BRUNNER, *Mr.* BALDWIN, *Mr.* BOND, *Mr.* J. STUART, *Mr.* BRIGG, *Mr.* FRY, *Mr.* LEES KNOWLES, and *Mr.* MUNTZ.)

STAINES RESERVOIRS BILL.

To-day the Committee resumed their inquiry in regard to the above Bill (see *ante*, p. 1220) after the Whitsuntide recess.

Mr. PEMBER said that Mr. Pope had asked him to make a statement which would be common to them both—namely, that during the recess they had had an opportunity of looking over the figures, and saw in the flux and reflux of the examination of witnesses it had been difficult to pick them out accurately. They had, therefore, prepared a certain number of tables, putting in consecutive shape all the figures which had been laid before the Committee up to now. These tables would be ready the following day.

The CHAIRMAN said that during the recess he himself had gone through the figures as they had been given in evidence; and he hoped there would be no discrepancy between those figures and the learned Counsel's tables.

Mr. POPE said they had thought it well to have these tables prepared because there had been some discrepancies.

The CHAIRMAN asked on what principle the average rate of supply per head was taken—was it on the census of the district, or was it taken at so much per head, dividing the daily supply by the number of houses, and then taking the number of people in each house?

Mr. PEMBER said he understood that the last-named method was the one employed.

The CHAIRMAN said he had tried to take the effect of the various figures; and had got it at six persons per house.

Mr. PEMBER: I think that each Company take a different number of heads per house; each knowing the circumstances of its own district, and the average number of occupants of the houses.

The CHAIRMAN: I want to know the principle upon which it is done. No doubt there is a reason for the multiple being different in each case.

Mr. LITTLER pointed out that the average number of persons per supply was estimated at 7·7 in 1884 in the case of the West Middlesex Company; and that this went down to 7·4 in 1894. In the case of the Grand Junction Company, the average in 1884 was 6·75, and in 1894 6·48; and with the New River Company, the average in 1884 was 7·44, and in 1894 7·25.

Mr. *W. Hunter*, who was under cross-examination when the Committee adjourned, was then called, and further cross-examined. He said that the Joint Committee did not propose to take any water out of the river when a less quantity than 250 million gallons a day was passing over the Bell Weir at Staines, or the equivalent (having regard to the water abstracted and to that brought in by the tributaries at that place) to 220 million gallons passing over Teddington Weir. It was evident that the abstraction of water could not result in the daily quantity passing over Teddington Weir falling below 220 millions.

Mr. FREEMAN: Supposing that the water is going down as it is, if you propose to affect it by some figure not exceeding 100 million gallons, you would enlarge the number of days on which the minimum quantity of water is passing down?

Witness: Not at all.

You mean to say that it makes no difference to the river what quantity of water you take out?—When we limit ourselves to taking from the 250 million gallons at the Bell Weir, we do not affect the flow below the 220 million gallons over Teddington Weir.

Does it not increase the number of days on which the minimum flow of 220 million gallons will go over the Weir?—It might have an effect down to 220 million gallons, but not below that.

About the supply per head. Do you recollect that the average figure estimated by the Water Companies before the Royal Commission as to supply in 1891 was 31·19 gallons per head per day of the estimated population?—Yes; and I remember that Sir Frederick Bramwell estimated that the amount of water which should be supplied was 20 gallons per head for domestic purposes and another 6 gallons for trade. The Royal Commission assumed that 35 gallons per head would be a reasonable amount.

Then, starting from that, do you find that in 1893 the Grand Junction Company were supplying on an average 48·02 gallons; the New River Company, 32·88; and the West Middlesex Company, 32 72?—Yes.

Turn to the same table taken from the same source in 1894. Do you not find that the Grand Junction average is 48·06 gallons; the New River, 31·16; and the West Middlesex, 33·08?—Yes. In 1895, the Grand Junction Company showed a rise of 8 per cent. over the two previous years; the New River, 4½d. per cent.; and the West Middlesex, nearly 8 per cent. In 1895, the figures were respectively 49 61, 33·06, and 35 67. In 1896, there was a considerable drop in January, February, March, and April; but in May the quantity came to within half a million gallons of what it was last year. We are estimating our requirements on the maximum of our needs in 1895 during the frost.

Have you not relaid your pipes so as to prevent a recurrence of the events of 1895?—Yes; but we must be prepared for the worst.

Do you think it would be fair to calculate your rate of increase in supply on the basis of the increase in 1884-85?—Yes. In 1885, the average supply of our Company was 15,235,000 gallons per day; in 1895, it was 19,220,000 gallons. In 1894, it was 18,403,000 gallons.

Supposing your rate of increase continued as in 1894, by 1908 would the increase be to 21,978,000 gallons?—Yes; but I would include 1895.

That was an exceptional year?—Yes; but we cannot prepare for exceptional years.

Witness (continuing) said that there was no proposal in the Bill, nor was there any suggestion in the original scheme put before the Commission, as to making provision to return water to the River Thames in time of drought. At such periods, it was proposed that the Companies should take whatever water they required for their customers from their storage reservoirs, rather than from the river. They would never draw water from the river when by so doing the quantity flowing over Teddington Weir would be reduced below 220 million gallons per day. When 250 million gallons or less were flowing over the Bell Weir, which were equivalent to 220 million gallons at Teddington, after the Companies had taken the supply agreed upon with the Thames Conservators—namely, 130 million gallons—nothing would be taken from the river.

The CHAIRMAN: The question is this—is there anything in the Bill to provide for water being put back again into the Thames?

Witness: No. We do not put water back again into the river at times of drought, but refrain from abstracting it at such periods.

By Mr. FREEMAN: The Companies had not agreed with the Thames Conservators as to the maximum amount of water they should take from the river in any one day; but they had proposed to the Conservators that the maximum should be 100 million gallons per day. The aqueduct had three syphons in its eight-mile course; and the fall would be 6 feet—the water flowing at a uniform depth of 5 feet. There would be sluices at intervals of a mile; and these would be used as required to maintain the water at an even depth, and in times of severe frost to flush the aqueduct and break up the ice.

By Lord R. CECIL: The additional lands which the Companies sought power to acquire by this Bill would be used for the construction of storage reservoirs in the future; Parliament would have to be applied to for authority to spend the necessary amount of money.

Re-examined by Mr. LITTLER, witness said that new works were urgently needed. With regard to the averages of supply which had been referred to, he would point out that it was not an average, but a maximum supply which the Company had to be prepared for—they must be ready to cope with the maximum drought and the maximum frost. The Companies were quite willing to come under obligation to the Committee to restrict themselves to taking no more than 100 million gallons of water from the Thames in any one day. Statistics showed that the storage accommodation which would be provided under the Bill would tide them over the most severe drought which had ever been known. If all the Water Companies joined and agreed to take their water and store it above the Bell Weir, the flow at Teddington would not be interfered with. The water would be taken at flood time, though not when it was turbid. There could be no doubt that the scheme of the Bill, if carried out, would be enormously to the advantage of the public as compared with the existing condition of things. As to the conduit being an open one, it would cost £100,000 to cover it in along its passage through the Commons lands. Instead of covering in, it was proposed to construct bridges over the aqueduct for the convenience of the public. These bridges would be put at con-

venient distances. There would be no embankment which would cut off the view; and with reference to the proximity of the sewage farm and cemetery to the reservoirs, as the Companies proposed to make the latter absolutely tight, there could be no danger of water percolating into them from these objectionable places. Besides, the reservoirs would be at a higher level than the cemetery or sewage farm.

By the CHAIRMAN: The Grand Junction Water Company had power to take 24½ million gallons of water from the Thames. They also had pipes in the gravel beds, and took 3 million gallons per day from that source. The water taken from the gravel really came from the Thames; and the Company, whatever their legal rights in the matter might be, included the amount in the 24½ million gallons which they had a right to abstract from the river. The Company in the property they already possessed had room for a reservoir to hold 200 or 250 million gallons. He pointed out that the large average amount of water consumed in the Grand Junction district was due, in a measure, to the class of consumer. They had a large number of hotels, clubs, flats, and extensive residential properties in the district. In these one person would use as much as 30 gallons of water for a single bath.

Mr. STUART asked if witness definitely withdrew from the position that the Grand Junction Company had no power to take water from the gravel beds in addition to the 24½ million gallons they took from the Thames under agreement with the Conservancy Board?

Witness said that was a legal matter, on which he was not competent to speak.

But it is a most important question in our investigation; because if you have a right to take water from the gravel beyond your 24½ million gallons, then you are not anything so near the limit of your resources as has been represented to us. The resources you claim to be at the end of are the 24½ million gallons?—The right to take water from the gravel is a disputed point, which has never been absolutely settled. I can only say that if Parliament will tell us that we may take water to a much larger extent than at present we appear to have the right to do, we shall be pleased to drop these proposed works.

The Committee are instructed to make provision for immediate necessities; and you are urging as an immediate necessity provision for your maximum needs. Could not that provision be made by allowing you to draw more water from the river when your maximum requirements were reached?—That is a question for the Committee. I do not, however, think that the needs of the Company would be sufficiently met or that it would be to the public interest to do what you propose. If we are to take more water from the Thames, we ought to have reservoirs in which to store it, according to the report of the Royal Commission.

You are in an occasional difficulty. If this can be met by taking water from the gravel, that should satisfy you?—Well, I do not think we ought to be left in a doubtful position in regard to this matter. It would not be wise to give us simply the power to meet our exceptional needs by increased draughts on the river.

Why not?—Because I think that precautions should be taken to keep the water flowing down the river as well as to keep the proper amount for consumption. As to schemes for bringing water from a distance, you are aware that engineers estimate that fifteen years would elapse before they could be carried out. It would be necessary in the meantime to make provision for getting the water required for immediate use from the Thames.

That could be urged as well upon the body Parliament proposes to entrust with the management of the water question as upon us?—When Parliament refused to give the East London Water Company the powers they sought in 1893, the result was a water famine. We do not wish to be placed in the same position.

Parliament did not permit that Company to take an extra supply from any source. You have a margin to draw from?—Yes; but you must consider also the New River and West Middlesex Companies, who are not situated as we are. We have joined with them in order to carry out a general scheme economically.

Mr. *J. T. Mills*, the Deputy-Governor of the New River Company, who was the next witness, said the Board of the Company had discussed this scheme, and were in favour of it; believing that this, or some such plan, was essential to enable them to discharge their duty to their consumers. As a matter of fact, it would be a source of loss and not of profit to them. In reply to the Chairman, witness said that adventurers' shares were not put on the Company's books as having capital value attached to them. An adventurers' share simply stood as such. It carried with it a seat on the Board, until the requisite number of members was made up, and a consequent fee; and for those reasons it was more valuable than a king's share. King's shares did not carry with them seats on the Board, for the reason that the King, when he held them, did not desire representation on the Board. As to the value of an adventurers' share, it varied from time to time; the largest amount given for one which had ever come to his knowledge having been £122,000. King's shares had been sold for as much as £95,000 and £98,000.

The CHAIRMAN: Can you tell me what dividend is paid on the shares—or is it a secret?

Witness: No, it is not a secret. The dividend paid on an adventurers' share is £2500. The same is paid on the king's shares.

Mr. POPE said that the progress of this Company was a curious story, which, as the inquiry proceeded, would be thoroughly put before the Committee.

Mr. *M. Hervey*, Engineer to the West Middlesex Water Company, said that Company had the right by agreement with the Conservators of the Thames to take 24½ million gallons of water from the river per diem. The powers of the Company for carrying out their obligations were nearly exhausted. They had carried out new storage works; and others were in process of completion, which would give them a storage of 300 million gallons, but they wanted water to put in the reservoirs. In order to keep up the supply, it was necessary to have power to send out more than the average amount required per day.

Friday, June 5.

On the resumption of the proceedings this morning,

Mr. BALFOUR BROWNE said more than once some words had been dropped as to an arrangement having been arrived at, or being in progress, between the promoters of the Bill and the Thames Conservators. It was inadvertently referred to as an agreement; and Sir Richard Wyatt at once denied that any agreement had been arrived at. At the same time, as the Committee would very well know from what had been said in the course of the inquiry, negotiations had been going on; and he thought it was only right that the Committee should be informed of what had taken place. If there had been any offer binding the promoters, it would be as well that they should know it.

Mr. LITTLER stated that there had been no offer accepted; and nothing binding had been done by the Conservators. What they had themselves proposed to the Conservators was that they should in no instance take more water in one day, whatever might be the condition of the river, than 100 million gallons. They also offered to make the further provision that they should not take for ordinary consumption and service purposes more than 52 million gallons. That was what was proposed; but whether the Conservators would accept it or not, it was for them to say. What he had indicated, the promoters were prepared to put in the Bill, as though it was a filled-up Bill.

Mr. BALFOUR BROWNE understood that these proposals had been submitted as an offer on the part of the promoters of the Bill to the Conservators.

Mr. LITTLER: We offer it to the Committee.

Mr. BALFOUR BROWNE remarked that that was even more binding. He asked the Committee to inquire whether the Conservators were to get anything for agreeing to the arrangement.

The CHAIRMAN: That is a question which is prominently in my own mind.

Mr. LITTLER stated that at present he was not in a position to say anything as to that; but, judging from past experience of the body, he did not suppose the Companies were likely to get anything out of the Thames Conservators for nothing.

Mr. BALFOUR BROWNE said he objected to a penny being spent out of the rates for the purification of any water from the Upper Thames. He wanted to know what was to be paid to the Thames Conservators under the arrangement referred to.

Mr. LITTLER repeated that no agreement had been entered into; but the promoters had offered to give the Conservators £4500 a year. They did not want to give it. If the Committee could convince the Conservators that the Companies ought to have the water and not pay anything for it, no one would be more delighted than he and those he represented would be. The promoters had no secrets at all from the Committee; they wished to put before them frankly all that was in their mind.

Mr. BALFOUR BROWNE said that he was contented with what his learned friend had stated. He would ask the Committee to question Sir Richard Wyatt, who was the only person present representing the Conservators, as to what he thought of the £4500 a year proposal.

Mr. LITTLER thought it was a little hard on the Thames Conservators that questions of this kind should be asked. The matter, however, was one of such public importance, that he, as representing the Companies, did not think he would be justified in keeping anything back.

Mr. J. STUART pointed out to Mr. Balfour Browne that the London County Council, in their petition, stated that no concession should be made to the Water Companies, unless the relations between the consumers and the Companies were revised. The learned Counsel so far had not dealt with that question at all in cross-examining the witnesses. He desired to know if the London County Council were dropping that part of their petition?

Mr. BALFOUR BROWNE said the same thing had been running through his own mind. If the Committee would look at the County Council's petition, they would see that there were various paragraphs in it as to which so far he had not cross-examined the witnesses at all. He would tell them why. The opposition to the Bill had been divided into two. His clients had first addressed themselves to the question of urgency. If there was no urgency, he understood that probably the Bill would not proceed; but if, on the other hand, there was urgency, then there were a great number of matters in the petition which would have to be gone into—one of which had just now been mentioned, and there were others which would take a very long time to deal with. He was entirely in the hands of the Committee as to whether they ought properly to go into the matter of their petition as in an ordinary case, or whether they should go on as they had been doing, directing their attention entirely to the question of urgency. They believed that they could show that, within the terms of the Instruction to the Committee, there was no urgency for the present Bill.

Mr. LITTLER failed to see how the Bill could be conducted on any other than the ordinary lines. His learned friend could not take his case piecemeal.

The CHAIRMAN: No, the case must be taken in the ordinary manner.

Mr. BALFOUR BROWNE: If you say it is necessary, I will cross-examine on all the points in our petition.

Mr. PEMBER said that if there were any points which the Committee did not think it desirable that his learned friend should go into, they, of course, would not be dealt with.

The CHAIRMAN: We have no right to try and form a judgment until we have the case of the three Water Companies before us. At present, we have only had the cases of two of them presented to us; but after to-day, probably we shall be in possession of that of the New River Company, and shall be much better able to form an opinion as to the further progress of the case than we are to-day.

Mr. LITTLER said that whatever point the petitioners wished to deal with before the Committee should be gone into in cross-examination in the ordinary way.

The CHAIRMAN remarked that, where endeavours were made to shorten cases of this kind, his experience was that they were always a great deal longer. He thought they had better go on with the New River Company's case. If, after they had heard it, they came to the conclusion that there was no urgency, there would be an end of the Bill; but if they considered that there was a degree of urgency, they would have to go into the points bearing upon that degree. In the meantime, however, they would go on steadily with the case of the New River Company.

Mr. *J. Francis*, M.Inst.C.E., Engineer to the New River Company, was the next witness. He said the amount of water supplied by the Company was 47,000,000 gallons per day—22,000,000 gallons from the New River, 24,000,000 from the Chadwell Springs, and 330,000 from the ponds at Hampstead and Highgate. The 330,000 last-named water was not used for domestic purposes. The amount consumed for domestic purposes, or suitable for such use, was 46 million gallons. Of course, a large quantity of the water was used for trade purposes. As showing the increase in the Company's operations, he pointed out that the supply in 1875 was 30,633,000 gallons per day; whereas in 1894 it was 43,121,000 gallons. The average daily supply during the week of maximum supply was, in 1875, 31,350,000 gallons; and, in 1895, 45,274,000 gallons. The rate of increase during the last four years was ten times as great as it was in the first four years of the last period of 25 years. The number of houses which received a constant supply was largely increasing, and had been so for some time. It was estimated that, in 1915, the daily supply would average 77,921,000 gallons. There would, of course, be a great deficiency in the Company's supply, unless powers were given for taking more water. He had examined the plans of Mr. Middleton's proposed new reservoirs at Staines, and considered that the works would answer all the requirements of the Companies admirably. The scheme would be much more economical and satisfactory than a plan under which each Company would make provision for acquiring and storing the water wanted to keep pace with the increasing demands on its own resources.

In cross-examination by Mr. Balfour Browne, witness said that he had given the Royal Commission to understand that the New River Company had 56,830,000 gallons of water available, if they possessed all the machinery necessary for working their wells to their fullest capacity. This was the amount of water the Company were sure of getting; but, of course, that would be very expensive.

The Chairman: If you can get the water, why do you come for these reservoirs?

Witness replied that the Company had another Bill which would come before the Committee, for enabling them to raise more water from their existing wells; but they wanted the Staines scheme as well. The Company had engine power sufficient to raise 34 million gallons of water per day; but the engines could not be kept constantly at work. Some allowance must be made for stoppages, for the oiling and breaking down of machinery, and so forth. The quantity of water the Company would require in future was under-estimated before the Royal Commission.

Mr. Balfour Browne said that, if the supply of water per head was to be 35 gallons, as the Royal Commission had estimated it should be, and the population in the Company's districts in 1885 was 1,070,000, and in 1895 1,151,000—or an increase of 81,000 in ten years—it would show that, with a proportionate increase in the population, the Company had surplus water to last them for 50 years.

Witness replied there was no indication that the supply per head would stop at 35 gallons. The habits of the consumers were changing; and the consumption was going up very rapidly. Besides, the supply was being changed from an intermittent to a constant one.

The Chairman: Has the storage been increased since 1892?

Witness: Not at all.

Where is your storage?—We have none, except subsidiary reservoirs, which only enable us to carry on our supply for a week.

In reply to further questions, witness stated that the Company possessed a number of wells, some of which had one, some two, and some three engines. There was a great difference in the yield of the wells, and in their diameter, and so forth. No doubt, if the powers the Company were seeking in their separate Bill were granted, the Company would be able to keep pace with the requirements of their consumers for some time without the reservoirs contemplated in the present Bill.

By Mr. Bond: The two Bills would only bring the Company 63 million gallons of water, and enable them to go on fairly for another 20 years.

Mr. J. Stuart: You need your increase of water most during the months when you are tried by the maximum consumption?

Witness: Yes.

You have reservoirs in the Bill to hold rather more than 2500 million gallons?—Yes.

And you claim one-third of that storage capacity?—Yes.

That would be 30 million gallons per day for four weeks?—Yes. Our position is not that we require it at a certain time of the year; in a very short time now we shall want it altogether.

I am taking the maximum first. Your greatest daily supply, which you anticipate you will require in 1906, taking your own figures as the basis of calculation, will be 63 million gallons a day. You have at present the power of supplying 46 million gallons a day. The difference between 46 and 63 is 17; therefore your maximum requirements in the year 1906 will be 17 million gallons above what it is in your power at present to supply. If you took the maximum week, it would be 21 million gallons more. Now, you are making a reservoir, do you estimate you cannot obtain 17 million gallons a day from that?—It depends upon what we are permitted to abstract from the Thames.

If you are allowed to take out of the Thames what the agreement foreshadows, do you think that you could not obtain 17 million gallons of water a day under that system?—Well, I have only a vague idea of what the agreement is. I would rather not answer that question.

By this Bill, according to your own figures, you would be getting water enough to meet your largest necessities until 1906 without the other Bill?—This should be pointed out: The present scheme is a large one, and will take some years to complete. We want water at once—or shall require it next year.

You want the present scheme, although it is not to supply you with water for some years?—Yes, it must take five or six years to construct the reservoirs.

You are here with a scheme which is to give you, six years hence, water enough to meet all your requirements, say, for ten years. Do you know that we, as a Committee, are sitting under an Instruction of the House, which is that we are to allow only such works as are immediately and urgently necessary?—Yes.

It is for us to interpret the meaning of the Instruction. The Bill that you are now promoting remains the same now as it was before that Instruction was moved?—It does.

By Sir J. Brunner: It would be necessary to come to Parliament for further powers before new pumping machinery is acquired by the Company.

Mr. *E. Collins*, M.Inst.C.E., Distributing Engineer to the New River Company, said he had been 16 years in his present position, and was therefore thoroughly acquainted with the distributing system of the Company. He had paid a great deal of attention to the question of the prevention of waste. They had 113,000 supplies under a constant supply; the districts being under waste meters. They had over fifty men engaged on the waste-meter system. The districts were isolated from each other; and the quantity of water sent into each in a given time was measured by the meters. Then these districts were subdivided into streets; so that the Company could see into which portion of the district the water was passing. Supposing there were 20 streets in a sub-district, they would be shut off one by one. In street No. 7 or No. 18, there might be no waste; while it might be found that it was to street No. 19 that the water was travelling. Having ascertained this fact, they took other means for further isolating the houses, and so preventing waste. This system enabled them to keep their waste staff employed in the most wasteful part of their district. The use of the best water-fittings was urged on their consumers; the Company stamping those they recommended. As a result, in the majority of cases, the consumers had been persuaded to have good, sound, serviceable fittings. Efficient fittings lasted for many years in a serviceable condition.

Mr. Littler: Do you find, as a general rule, the introduction of a constant supply has or has not tended to increased consumption?

Witness: We find that it has. The tendency is for the people to consume more water. All the newer houses have baths, and are fitted with hot and cold water. Large quantities of water are used in baths and for garden watering in the hot weather. While ordinary street-watering has not increased to any great extent, there has been great developments in the direction of street-washing in the City, the Strand, St. Giles's, and kindred districts night and morning. Then the waste of water is great during frosty weather, not only through broken pipes, but owing to people letting the water run all day and night to prevent the freezing of the pipes. The use of water for many trades and manufactures is on the increase. In short, the needs of the Company are growing from day to day; and if the Company are to fulfil their duty to the public, and discharge their statutory obligations, it is necessary that they should have more water.

The Committee then adjourned till the following Tuesday.

Extension of Water-Mains in New York.—A sum of $1,000,000 for new water-mains in New York City is authorized by a legislative statute just signed by Governor Morton. It is said that the Bill provides for two mains down Fifth Avenue. At present eight 48-inch mains lead down into the city from the new aqueduct—four going to the Central Park reservoir, and four connecting with the distributing mains.

The Defective Reservoir at Redruth.—The question of the repair of the leaky reservoir has been again before the Redruth District Council. After consideration of the suggestion put forward by Mr. Nicholls, the Engineer of the scheme, to which reference was made in the "Journal" for the 26th ult. (p. 1184), the Water Committee recommended that tenders be obtained from responsible firms, including Messrs. Callender, the makers of a bitumen lard for rendering the reservoir water-tight, and maintaining it in working order for at least six months. It was explained by Mr. Carkeek that the Committee thought it would be better to make some firm responsible for the work, rather than undertake experiments on their own account. Captain Hooper furnished the additional information that the Committee were reluctant to speculate perhaps £1000 on the work; and Mr. Tweedy expressed the opinion that though it was possible to make a place water-tight the cost was a serious consideration, and that if they could get a contractor to do it for £300 or £400, it would be better than taking any further risk themselves. In answer to a question whether the reservoir could be filled if it were made water-tight, Mr. Carkeek said there was plenty of water in winter, when they wasted 9 million gallons. Mr. J. Hicks suggested that, before any further action was taken, the Committee should get rid of the original contractor. The recommendation was adopted.

Sheffield Corporation Water Department.—At last Wednesday's meeting of the Sheffield City Council, Alderman Clegg sought from the Chairman of the Water Committee some information as to whether, apart from the extraordinary expenses arising from the frost in 1894-5, the progress of the undertaking had been satisfactory. In reply, Alderman Gainsford said that in the report of the Manager (Mr. W. Terrey) there was a statement showing the additional expense incurred in consequence of the frost. Those expenses were partly borne by the year ending March 25, 1895, and partly by the year which had lately closed; and they amounted altogether to £10,620—£1156 in 1895, and £9464 in the year recently ended. The progression of affairs had been that they began in the first year, 1889, with a total deficiency of £5120. That deficiency grew less and less, until in 1892 it was turned into a surplus, which surplus continued, without much alteration, through four years, until the year 1895—the first of the two years affected by the frost—which showed a surplus of £1798; and if it had not been for the frost, there would have been a further surplus of £1156. Therefore, but for the frost, the surplus in 1895 would have been £2954—a considerably larger sum than in the previous years. For the year ending March last, the figure brought out in the accounts was a deficiency of £3797; but there was an expenditure due to the frost of £9464. If they took one item from the other, it showed that, but for the frost, there would have been a surplus of £5666—almost double that of any previous year. Regarding the figures in this way, they showed that there had been, not merely a satisfactory, but a really extraordinary, progress in the department.

LEGAL INTELLIGENCE.

SUPREME COURT OF JUDICATURE.—COURT OF APPEAL.

Tuesday, June 9.

(*Before Lords Justices* LINDLEY, LOPES, *and* RIGBY.)

Patterson v. The Gaslight and Coke Company.

This was an appeal by the defendant Company from the order of Mr. Justice Kekewich (see *ante*, p. 634), restraining them from stopping their gas from entering the premises known as the Albert Bridge Flour Mills, occupied by Messrs. Marriage, Neave, and Co., Limited, who had recently gone into liquidation; the business being carried on by a Receiver and Manager for the debenture holders. The principal point was whether Receivers and Managers were "occupiers" within the meaning of the Act.

Mr. WARRINGTON, Q.C., and Mr. DANCKWERTS appeared for the appellants; Mr. RENSHAW, Q.C., and Mr. KIRBY represented the respondents.

Lord Justice LINDLEY, in delivering judgment, said: This was an appeal by the defendant Company from an order of Mr. Justice Kekewich, by which it was in substance declared that they were bound to supply the plaintiffs, who were Receivers and Managers of a business, with gas without the performance by the plaintiffs of a condition which the Gas Company said they were entitled to insist upon—viz., paying for the gas supplied to Messrs. Marriage, Neave, and Co., prior to Christmas last. The case was somewhat complicated; and turned upon a great number of Gas Acts. On Nov. 6, 1883, Messrs. Marriage, Neave, and Co., who were carrying on business at the Albert Mills, Battersea, entered into the usual agreement with the Gas Company to take gas; and in June, 1890, they borrowed money on first and second debentures. Both debenture deeds were in the usual form, and contained a clause enabling the debenture holders to appoint receivers. On Feb. 6, 1896, the trustees for the debenture holders under the second deed appointed a Receiver, who took possession of the mill on Feb. 7. On the 17th, the Court appointed the plaintiffs Receivers and Managers under the first deed; and they took possession under that. On Feb. 26, 1896, the Gas Company gave notice to the plaintiffs that the Mill Company owed them the sum of £90 14s. 5d., in respect of gas supplied up to Christmas, 1895; and they also informed the plaintiffs that if they did not pay this sum of money, they would decline after a certain time to supply them with gas in future. The Receivers and Managers found they could not carry on the business—especially in the month of February—without a supply of gas. They were always ready and willing to come to terms with the Gas Company for a future supply—there was no difficulty about that; but the Gas Company said, "No, you must pay us the £90 odd, and if you do that we will supply you without any difficulty." There was never any controversy between the parties, except as to the right of the Gas Company to stop the supply of gas if the plaintiffs refused to pay the £90 odd. The plaintiffs were not prepared to do that. They maintained that they were entitled to a supply of gas without performing this condition; and on March 5, 1896, they commenced this action, in order to have it declared that they were so entitled. It was important to observe that the sum in dispute became due from the Mill Company while the debenture holders' security was a floating security. It was also important to bear in mind that the gas never was, in fact, cut off; no new or fresh supply was wanted; no pipes had to be laid down; and no meter had to be provided. The question turned upon the true construction of a number of sections contained in three Public and three Private Acts of Parliament. It was quite sufficient to say that the Acts began in 1847 and ended in 1872; and they had been discussed with great care in Court. An examination of these sections by Counsel in Court, and a perusal of them by their Lordships since, showed that there were two series of sections which needed attention. The first series entitled owners or occupiers generally to require a supply of gas. This series, which did not govern the decision in the present case, consisted of sections 14 and 15 of the Public Act of 1860, sections 12 to 15 of the Private Act of 1870, and section 11 of the Public Act of 1871. The other series was that which entitled the Gas Company to refuse to continue to supply places to which gas had been supplied and not paid for, and began with section 16 of the Public Act of 1847, and ended with section 18 of the Company's Private Act of 1872; the latter series being the only sections which governed the question before the Court. It was clear from the language of these sections, first, that the Gas Company were entitled to refuse to supply gas to the Mill Company unless, and until, the £90 was paid; and, secondly, until that sum was paid, the Gas Company were entitled to refuse to supply gas to the mill at the request of anyone, unless he was in some better position than the Mill Company. Were the Receivers appointed by the Court, at the instance of the debenture holders, in a better position in that respect than the Mill Company? He (his Lordship) was of opinion that they were not. The right of the Gas Company to refuse to supply the gas unless the £90 was paid, had accrued before any Receiver had been appointed, although the notice of such right was not given till afterwards. The Receiver appointed on Feb. 6 was in no better position than the Mill Company. The Receivers appointed on Feb. 17 were technically appointed under the trust deed. But, at the same time, the Receivers appointed by the Court were appointed for the benefit of the debenture holders; and having regard to the nature of their security and to the obligations imposed by statute on the Gas Company to supply gas to the mill, it would be very unjust if the debenture holders could enforce this obligation against the Gas Company without complying with the condition of paying for the gas previously supplied. The plaintiffs, being Receivers and Managers appointed by the Court, were lawfully in possession of the mill, and were entitled to use the name of the Mill Company for any purpose to enable them to discharge their duties. Therefore the plaintiffs could require gas to be supplied to the mill after paying the sum due to the Gas Company previous to their appointment. It had been contended that the plaintiffs could simply, as occupiers of the mill, have required gas to be supplied without demanding such supply in the name of the Mill Company. This was the view adopted by Mr. Justice Kekewich. The term "occupier" was ambiguous; in one sense a caretaker was an occupier. The sections relied upon as entitling the plaintiffs to require a supply of gas as occupiers, contained nothing negativing the right of the Gas Company to withhold such supply until the previous supply was paid for. The two sections must be read together. This brought one back to section 18 of the Act of 1872. This section, although badly worded, had no application to such a case as that before the Court. It did not apply to persons simply in the possesion of the premises of a defaulting consumer, to manage such business for the benefit of the creditors. The statute provided for a change of possession of quite a different nature. The plaintiffs' rights as Receivers and Managers were merely those of custodians of the mill property. The relation of the plaintiffs to the Gas Company was precisely similar to that of the Official Receiver in Smith's case (1893, 1 Q.B.D.). In Smith's case, the Official Receiver took possession of the debtor's business premises; but it was held that he was not entitled to a future supply without paying the amount due by the debtor for the gas consumed previous to his appointment. This decision appeared to be correct; for the Official Receiver was only in the position of a caretaker. The appeal would be allowed, and judgment entered for defendants, with costs both in this Court and the Court below.

Lords Justices LOPES and RIGBY delivered judgments to the same effect.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Saturday, June 13.

(*Before Mr. Justice* CHITTY.)

The Incandescent Gas-Light Company, Limited, v. Putz and Co.

This case came before the Court as a short cause upon motion for judgment. The statement of claim alleged that the plaintiffs were owners of certain letters patent which the defendants had infringed; and an order was asked to restrain infringement, for delivery up of the infringing mantles, and for payment of costs. The defendants were manufacturers and importers of the infringing mantles. The action had been standing over for some time—an order having been made that, upon the defendants undertaking to keep an account, the trial should be postponed until after the test action against Mr. Fear had been disposed of; it being arranged that the defendants should be bound by the decision come to in that case. Judgment was obtained against Mr. Fear on the 6th inst. (see *ante*, p. 1275); and a similar order was now asked against Putz and Co., who did not appear.

His LORDSHIP made the order as asked.

A similar order was made in twenty other cases—the defendants having purchased the mantles of Putz and Co., and having agreed to be bound by Fear's case.

Incandescent Gas-Light Company, Limited, v. Madge.

A similar order was applied for in this case.

Mr. HAMILTON, for the defendant, objected to an inquiry as to damages. He said his client had made about £3 out of the sales, and he was willing now to pay £5 by way of damages, to submit to an injunction, and to pay the costs.

The offer was not accepted.

His LORDSHIP accordingly made the order as asked.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Thursday, June 4.

(*Before the* LORD CHIEF JUSTICE *and a Special Jury.*)

Lawrence v. The East London Water-Works Company.

In this case, Joseph Lawrence, a dock labourer, sought to recover damages from the defendant Company for injuries which he alleged he had sustained by tripping over a fire hydrant in Arcadia Street, Poplar. The case for the plaintiff was that the hydrant in question was not in a proper condition, and that the defendants, under whose control the hydrant was alleged to be, were guilty of negligence. The defendants denied that the hydrant was defective, or that it was under their control.

Mr. KEMP, Q.C., and Mr. LYNDEN BELL appeared for the plaintiff; Mr. CRIPPS, Q.C., M.P., and Mr. R. M. BRAY represented the defendants.

Mr. LYNDEN BELL, in opening the case, said the sole question was whether on the 29th of March, 1895, when the plaintiff met with the accident, the hydrant in question was in a proper condition or not. Six of the jury had recently been to view the hydrant; and it was admitted by the plaintiff that it was now in a proper condition. At the time of the accident, however, it was undoubtedly loose, and the suggestion was that it had since been put right.

Joseph Lawrence, the plaintiff, was called in support of his claim. He said he put his left foot on the covering-plate of the hydrant, and this caused the plate to tilt. In bringing his right foot forward, it struck against the plate, causing him to fall and break his leg. The accident occurred about eight o'clock in the evening.

James Gibson, a resident in Arcadia Street, deposed to having seen the accident, and assisting the plaintiff afterwards. When he went to pick him up, one side of the plate was projecting, and it was loose.

Mr. *Newman*, a clerk, deposed to having tripped up on the hydrant plate in question in March last year. He said the plate at that time was loose, and moved when trodden upon.

Mr. CRIPPS, for the defence, said his case was that the hydrant had not been in any way altered since the accident, and that it was in as safe a condition then as it was now.

Mr. *Allen*, a representative of Messrs. Blake Brothers, the makers of the hydrant, said he identified it as one that left their works in July, 1893. He inspected it a week ago, and was satisfied that it had not been altered in any way since it was made.

Mr. *W. White*, Inspector of Fire Hydrants to the London County Council, said the hydrant in question was fixed on July 7, 1893. Nothing whatever had been done to the covering-plate since it was first put in position. The plate was kept in its place by its own weight.

Mr. *J. Godfrey*, the Superintendent for the London district of the defendant Company, said he had examined the books of the Company, and found that no repairs had been done to the hydrant plate in question. He went to look at it soon after the accident, but could see nothing whatever the matter with it.

Mr. *W. B. Bryan*, M.Inst.C.E., the Chief Engineer of the Company, said it would be impossible for the hydrant covering-plate to rock in the way alleged unless something were placed under it purposely.

Mr. *L. Hebler*, the General Superintendent of the Company, also deposed to having inspected the hydrant plate, and spoke to its immoveable condition.

A member of the fire brigade and several police constables were called, and they all deposed that they knew the fire hydrant in Arcadia Street, but had never seen anything wrong with it.

Mrs. *Feilder*, a resident in Arcadia Street, said she saw the witness Gibson picking up the plaintiff after the accident. This was somewhere between twelve and half past at night.

Council having addressed the Jury for their respective clients,

The Lord Chief Justice summed up the case; leaving it to the Jury to find whether or not the defendants had been guilty of negligence.

The Jury, without retiring, brought in a verdict for the defendants; and judgment was entered in accordance with the finding.

WESTMINSTER COUNTY COURT.—Friday, June 12.

(*Before Mr.* Lumley-Smith, Q.C., *and a Jury.*)

Barnett v. The Incandescent Gas-Light Company, Limited, and Fowler.

This was an action brought by David William Barnett, a traveller in gas-fittings living at Clapton, for damages for malicious prosecution.

Mr. Nash, in opening the case, stated that in May, 1894, his client called upon Mr. Fowler, who carried on business as a wine merchant in Chatsworth Road, Clapton. At that time, plaintiff was a sub-agent for the defendant Company; the agent being a Mr. Thomas. Mr. Fowler had four incandescent gas-lights; the burners and mantles being of the Company's make. Plaintiff tried to get a further order from Fowler; and in August of the same year he sold him two more lamps—the difference in these being that whereas the burners and mantles of the first were the Company's, only the mantles of the second lot were theirs, the burners being the Deimel pattern. The whole lot cost £5 2s. 6d. For nearly two years, Mr. Fowler used these lamps; and, so far from being dissatisfied with them, he recommended plaintiff to other people. On March 19 last, a summons was issued charging the plaintiff with obtaining money under false pretences; and the case was heard at the North London Police Court—the plaintiff being committed for trial (see *ante*, p. 706). To show malice, he pointed out that the summons was issued for the amount for which all the burners and mantles were sold; and even when the Company withdrew a part of the charge, they went in for 29s., which included the price of their own mantles. The Company had no right to interfere—the plaintiff having done nothing which was wrong. In October, 1894, the Company supplied mantles with a limited licence—*i.e.*, they only sold them conditionally on their being used with their burners; but this was months after the plaintiff had dealt with Mr. Fowler. In order to enforce the Company's rights in a Civil Court, his (Mr. Nash's) view was that they had taken criminal proceedings against his client. He was not allowed to communicate with his friends; and for two days was in prison until he could get bail. When the case came before the Grand Jury, they threw out the Bill (see *ante*, p. 988).

Plaintiff was called and deposed to these facts. He said he was to be paid by Mr. Thomas on commission. On the second occasion when he sold the Deimel burners, Mr. Fowler remarked that they were not of the same pattern as those he had first sold him; and he replied that they were of a different make. The Deimel burners cost a little less than the Welsbach burners. The former cost him 3s. 6d. each; and the latter were sold for 15s. each, with 30 per cent. off. He made a clear profit of about 10s. on each burner. At this time the Welsbach Company had not established their right even to the mantle. At the Police Court, both Mr. Fowler and the Manager of the Company gave evidence against him. The proceedings against him had ruined his business. At the time they were taken he was sub-agent for the Incandescent Gas-Light Company, and agent for the Deimel and Champion Companies; and he was now agent for the Meteor Company. As soon as he came out of prison, notice of an injunction was served upon him by the Incandescent Company.

Cross-examined by Mr. Glascoe, who defended, witness said he was sub-agent for the Welsbach people for six weeks; and when he sold the first burners to Mr. Fowler, he was working with Mr. Thomas. The Welsbach Company allowed him 30 per cent.—the agent's discount—on the burners he had of them. He never reported any sales to the Company. On the first occasion he showed Fowler the Welsbach Company's catalogue; but on the second, he told him that the burners were of a different pattern, and that he could allow him a commission on any customers' orders he might introduce. He could not say whether or not he mentioned the name of another company. He had put up burners since. He had never said he was agent for the Company. When he sold a Mr. Hindmarsh some burners, he did not sell him mantles, but supplied him with some later.

Re-examined: The actual cost of the Welsbach burner was less than 1s. each. He only used the Company's catalogue to show the kind of burner and globe.

Mr. Nash put in the answers to interrogatories, which showed that the Company's Solicitor did not apply for the summons against plaintiff on behalf of the Company, but asked Mr. Fowler and others to prosecute him, and said they would (and they did) assist them.

Mr. Glascoe submitted that there was no case to answer; and then the question arose as to whether or not the Company were liable. But the Company had no desire to take that point. There was no evidence of malice.

Mr. *John R. Hindmarsh*, a cutter in Beach Street, Barbican, E.C., called by Mr. Glascoe, deposed to seeing the plaintiff in August, 1895.

Mr. Nash submitted that this witness could not be called.

Mr. Glascoe said he desired to show that the facts in four cases were before the Company when the informations were sworn. All the cases were in 1894 or 1895, excepting one, which was in the early part of this year. On the 2nd of March, the case of Hindmarsh was commenced at the Guildhall, and plaintiff was then committed for trial. After that, the case of Fowler was taken.

His Honour asked whether, if a man did something wrong in 1895 and 1896, this was evidence that he had done something wrong in 1894.

Mr. Glascoe said it was unnecessary for him to consider whether there was any truth in it or not, so long as he believed what he was told.

His Honour said he thought the prosecutors ought to be able to show what they acted upon.

Mr. Nash submitted that this was only a question of credit; and evidence on the point could not be given. The objection was therefore sustained.

Mr. *Gutch*, the Assistant-Manager to the Company, said that in 1894 the Company fixed a price for a burner, mantle, and chimney complete. Mantles were supplied separately; and the price was very low—being 1s. 3d. each. The Company had had difficulties owing to people selling someone else's burners, and fitting their mantles to them; and they took action against the persons selling and using them. Their inquiry officer reported to him that Fowler was using the infringin burner. Fowler called upon him, and said he had bought some burners of Barnett, who professed to be an agent for the Company, and that he believed them to be the Company's burners. Hindmarsh also told him he had bought of Barnett, who said he was the agent of the Company. He carried a bag with several kinds of burners in it. Barnett was never the agent of the Company.

By Mr. Nash: He believed that Fowler would have prosecuted whether the Company had interfered or not. They considered they had a right to interfere, because people sold inferior burners with the Company's mantles. They had commenced actions against the plaintiff and 150 other people.

Mr. *Fowler*, a wine and spirit merchant, of Chatsworth Road, Clapton, said he decided to have several burners on trial, and paid 14s. 6d. each for them. About a month afterwards he had two more put in; and he believed they were the Company's. He assumed on the second occasion that plaintiff was the agent of the Company, as he had said he was when he first called; but when plaintiff put up the second lot, he said they were of a different pattern.

Cross-examined: Had he known they were not Welsbach burners, he should not have had them; but he noticed that the patterns were different.

Mr. Glascoe desired to call Hindmarsh and others as to what took place when they had transactions with the plaintiff.

His Honour declined to admit this evidence. He said that what he proposed to leave to the jury was whether or not the defendants prosecuted—and this he did not understand to be seriously disputed—and whether what they did was maliciously done.

Mr. Glascoe submitted to the jury that the Company were justified in the steps they took, as the plaintiff had no right to say he was the agent of the Company.

Mr. Nash argued that the Company had no legal ground for claim against the plaintiff, as what took place at the sale was in 1894, and the notice on the burner box was not there for a long time after that. Had Mr. Fowler known his rights, he would never have taken the burners down.

His Honour, in summing up, said the plaintiff had to show that the prosecution was malicious, and without reasonable and probable cause. Barnett did not dispute that when he sold the first burners he was the agent of the Company; but on the second occasion he supplied cheaper burners and the Company's mantles. Two years afterwards, Fowler found himself in conflict with the Company, who said they had a right to insist that their burners should be used with their mantles. The Company therefore, after hearing what Fowler had to say, declared that they honestly believed it to be true; and he should ask the jury that question. Then there was the further question of malice; and what was suggested was that the Company prosecuted, not because they thought Barnett had defrauded Fowler, but in order to crush him, because he was a thorn in their side. There was always a great deal of infringement of any patent that was of any use; and the Company had a right to take civil proceedings to prevent it. But they could not take criminal proceedings unless a man had been dishonest; and the suggestion was that the reason the Company prosecuted was to stop the plaintiff. The last question was as to damages; and on this it seemed clear that the plaintiff sailed very close to the wind.

The jury, after a lengthy consideration in private, found that both defendants prosecuted; that Fowler believed the charge to be true, but the Company did not; and that the Company maliciously prosecuted. They gave a verdict for the plaintiff against the Company, with £10 damages.

His Honour said that, in his opinion, there was absence of reasonable or probable cause; and he gave judgment according to the finding of the jury, with costs—remarking that it was hopeless to expect to get a conviction upon verbal evidence given two years after an event. To put the criminal law into motion was a serious thing.

Judgment was then entered for the plaintiff for £10 and costs against the Company, and for Fowler without costs. It was intimated that there would be an appeal.

The Tarapaca Water-Works Company, Limited.

In the Chancery Division of the High Court of Justice last Tuesday, Mr. Justice Kekewich had before him an action and a counter-claim in which Messrs. W. and J. Lockett, merchants, of Liverpool, asked for

a declaration that certain shares in the Tarapaca Water-Works Company belonged to them. The Company also claimed to have a lien on the shares. Mrs. E. Hart, the transferor of the shares to the plaintiffs, was joined in the case as a defendant. On the case being called, Mr. Warmington, Q.C., who with Mr. MacConkey appeared for the plaintiffs (Mr. Cozens Hardy, Q C., and Mr. Macnaghten being for the Company and Mr. Ingle Joyce for Mrs. Hart), stated that the action had been settled. An order would be taken by consent for payment to the plaintiffs of a sum of money to be realized out of the sale of certain of the shares, and there would be no costs on either side. His Lordship said the order must go accordingly.

The Incandescent Gas-Light Litigation.

In the Court of Appeal, last Wednesday, Mr. Walter applied to the Master of the Rolls and Lords Justices Kay and Smith for leave to withdraw the appeal which had been presented by the Incandescent Gas-Light Company, Limited, from the decision of Mr. Justice Wills (see *ante*, p. 876); and their Lordships assented upon the terms of the applicants paying the costs.

The Sewerage of Sunbury-on-Thames.

In the Queen's Bench Division of the High Court of Justice, on the 3rd inst., before Justices Cave and Wills, the Attorney-General (Sir R. E. Webster, Q.C., M.P.) moved for an order *nisi* for a *mandamus* against the Urban District Council of Sunbury-on-Thames for the enforcement of obedience to a Local Government Board order of December, 1891. In 1891, complaint was made to the Board that the Sanitary Authority of Sunbury had made default in not providing proper sewers. An inquiry was held, and an order was made under the 299th section of the Public Health Act, 1875. On Oct. 12, 1894, the duties and liabilities of the then Guardians of the Poor of the Staines Union were transferred to the Urban District Council of Sunbury. The affidavits showed that nothing had been done during the years 1894 and 1895 to obey the order. No land had been acquired, although statutory powers had been conferred by Act of Parliament. At the last moment, the District Council said they intended to carry out the matter; but there had been such delay that it was felt necessary to apply for a *mandamus*. Their Lordships, in granting the rule, said the case seemed to show the value of the alternative remedy given by the section, of appointing somebody to do the work.

The Charge of Perjury in Connection with the Southwark Bridge Explosion.

At the Lambeth Police Court, last Wednesday, James Price, 38, a lighterman, living at Acton, was again charged on remand with committing wilful and corrupt perjury in his examination upon oath before a Judge at the Lambeth County Court (see *ante*, p. 1115). Mr. Avory prosecuted; Mr. Jonas defended. The case, it will be remembered, arose out of an action which the prisoner brought against the South Metropolitan Gas Company to recover damages for personal injuries which he alleged he sustained in the gas explosion which occurred on Southwark Bridge in February of last year. Further evidence having been given for the prosecution, Mr. Sheil committed the prisoner for trial, but said he would take bail—himself in £100, and two sureties in £50 each—for his appearance.

Colombo Gas and Water Company, Limited.—The accounts of this Company for the year ending Dec. 31 last show a very satisfactory increase over those for the preceding year; and the balance of revenue account amounts to £4843, as compared with £3459 in 1894. The Company have made steady progress in the past four years. In 1892, the gas and lamp rentals amounted to £13,102; in 1893, to £13,388; in 1894, to £14,903; and in 1895, to £17,918. At the last meeting of the Company, a dividend of 7 per cent. was declared upon the preference shares, and one of 2 per cent. upon the ordinary shares. The Company's Memorandum of Association has been altered so as to greatly enlarge the powers of the Company in respect of the supply of stoves, fittings, &c., or the electric light, or to undertake lighting by any other illuminating agent.

Incandescent Gas Lighting at Beckenham.—Our local correspondent writes: "The following report on the experiments with incandescent gas-lighting, has been prepared by the Surveyor to the Beckenham District Council; and it will probably result in the complete abandonment of the agitation which was being raised in certain quarters for the adoption of the electric light: During the six winter months, Nov. 1 to May 1, saving in gas about half a cubic foot per hour per lamp, or about 12½ per cent.; average number of mantles used per lamp, 3; average life of mantle, 60½ nights (766 lighting hours); maximum life of mantle, 143 nights (1859 lighting hours); minimum life of mantle, 6 nights (86 lighting hours); average life of mica chimney, 4 months; cost per lamp of mantles and chimneys, 4s. 9d.; saving of gas per lamp, 2s. 11d.; net loss per lamp, 1s. 10d.; net loss over whole of district lighted—viz., 670 lamps—£61; estimated annual loss over whole of district, £103, or 3s. 0¾d. per lamp; capital cost of adopting lamps to incandescent lighting, £500, which would be increased to £1100 if burners with reflectors and special lanterns were used; illumination increased 350 per cent.; cost increased 5 per cent. This result, which has been obtained by the Welsbach system, is considered very satisfactory by the Council; and they have ordered the experiments to be continued with other systems, with a view to adopting the one which shows the best features and suitability for the neighbourhood. Most of the members of the Council are, however, already satisfied that an additional 350 per cent. of lighting power, at such a moderate extra outlay, is a remarkable economy, which cannot be much improved upon."

MISCELLANEOUS NEWS.

ASSOCIATION OF SULPHATE OF AMMONIA MANUFACTURERS.

The Annual Meeting of this Association was held on the conclusion of the business of The Gas Institute last Thursday, at the Society of Arts, John Street, Adelphi—the chair being occupied by Mr. W. R. Chester, M.Inst.C.E. The attendance was very meagre.

The Honorary Secretary (Mr. G. E. Davis) read the minutes of the last annual meeting, which were duly confirmed, and the report of the Council. This stated that the register now contained the names of 100 manufacturers; that a price list was issued bi-weekly; that there had been no legal expenses during the year; and that there was a balance of £118 to the credit of the Association, so that next year there would be funds available for the distribution of literature, and other purposes. The report also included full statistics of the exports of sulphate during the year.

On the motion of Mr. Isaac Carr, seconded by Mr. C. A. Craven, the report was adopted and ordered to be printed and circulated among the members.

A long discussion ensued on the best means of furthering the objects of the Association; and a resolution was ultimately carried empowering the Council to approach the Royal and other agricultural societies, with a view to offering prizes for the use of sulphate of ammonia as manure.

The Council for the ensuing year were then elected—Mr. W. R. Chester being continued as President, and Mr. G. E. Davis as Honorary Secretary.

GAS AND WATER PROVISIONAL ORDERS (SESSION 1896).

Consent of Local Authorities Dispensed With.

In compliance with section 4 of the Gas and Water Works Facilities Act, 1870, the Board of Trade have lately reported that they have granted certain Provisional Orders—viz., those relating to Chester-le-Street and Pelton and to Hemel Hempstead—notwithstanding that the consents of some of the authorities concerned were withheld. The Board have furnished the following particulars in regard to these matters:—

Application was made by the Parish Lighting Company, Limited, for authority to maintain and continue their existing gas-works, to construct additional works, and to manufacture and supply gas, in the townships of Chester-le-Street and Pelton, in the county of Durham. The following local and road authorities were interested: The Chester-le-Street Parish Council, the Pelton Parish Council, the Chester-le-Street Rural District Council, the Durham County Council, and the Durham and Chester-le-Street Highway Board. The consents of some of these authorities were not obtained—the principal objection being to the price proposed to be charged for gas; and the promoters made application to the Board of Trade to dispense with such consents, under the powers conferred upon them by section 4 of the Gas and Water Works Facilities Act, 1870. The Board of Trade thereupon appointed Lieut.-Col. H. A. Yorke, R.E., as Commissioner to hold a public inquiry at Chester-le-Street with reference to the application for the Order, and to report to them on the matter. Colonel Yorke reported that, having considered with much care the evidence placed before him on behalf of the promoters and the objectors, he was strongly of opinion that it would be for the public benefit if the supply of gas to the townships of Chester-le-Street and Pelton were in the hands of a company having statutory powers and with statutory obligations. Subject, therefore, to a modification of the maximum price proposed in the draft Order, Colonel Yorke recommended that the Order should be granted. The Board decided to grant the Order, and to give effect to Colonel Yorke's recommendation by substituting a standard price of 2s. 9d. per 1000 cubic feet, with sliding-scale as to price and dividend, for the proposed maximum price of 5s. per 1000 cubic feet.

The Hemel Hempstead Provisional Order was applied for by the Hemel Hempstead Water-Works and Laundry Company, Limited; and its objects were to empower the Company to maintain and continue water-works, to construct additional water-works, to supply water in and to parts of the parishes of Hemel Hempstead, St. Michael's, and Abbots Langley, and the parish of Redbourn, in the county of Hertford, and to raise additional capital. Several of the local and road authorities objected to the application being granted; but, with the exception of the Hemel Hempstead Parish Council, they withdrew their opposition, after certain amendments had been made in the Order. The promoters applied to the Board of Trade, in pursuance of the above-named section of the Gas and Water Works Facilities Act, to dispense with the consent of the Council. The Board of Trade accordingly appointed Lieut.-Col. H. A. Yorke, R.E., to hold a public inquiry at Hemel Hempstead with respect to the application, and to report to them thereon. Colonel Yorke reported that, subject to certain reductions which he suggested in the maximum charges which it was proposed to authorize, to the insertion of a clause providing for compulsory purchase by the local authority, and to certain other minor amendments, he was of opinion that the Order should be granted. Acting upon his recommendations, the Board decided to dispense with the consent of the Hemel Hempstead Parish Council, and to grant the Order, with the amendments above referred to.

The Proposed Purchase of the Chichester Water-Works.—A private meeting of the shareholders of the Chichester Water Company has been held to consider the proposal of the Chichester Town Council to acquire the Company's undertaking at the rate of £23 per share, amounting in the aggregate to £47,000. A majority of the shareholders in attendance were opposed to the Company negotiating on the terms mentioned; but the proxies held by the Chairman (Alderman Smith) enabled the supporters of the proposal to carry a resolution in favour of disposing of the undertaking.

DENTON GAS SUPPLY.

The accounts of the Gas Department of the Denton Urban District Council for the year ending March 31 last, as certified by Messrs. Nairn, Son, and Pollitt, of Manchester, have been issued. The net receipts from the sale of gas in that period amounted to £8325; the amount realized from the sale of residuals and the profit on fittings bringing this up to £10,402. The expenditure on the manufacture of gas came to £4429; on distribution, to £591; and on management, to £688—leaving £4694 to be carried forward. Of this sum, £2699 was required for interest and annuities, and £882 for sinking fund charges; so that the net profit at the close of the year was £1113. The following figures are taken from the particulars of gas manufacture, &c., for the years 1894-5 and 1895-6, furnished by the Gas Manager (Mr. J. Chadwick Smith):—

	Year 1895-6.	Year 1894-5.
Cost of cannel and coal	£2915 7s. 10d.	£3002 4s. 4d.
Quantity used in tons	6414	6287
Average price per ton	9s. 1·09d.	9s. 6·60d.
Total make of gas, cubic feet	70,292,000	68,487,500
Total sale of gas, cubic feet	64,040,700	60,896,880
Gas unaccounted for	6,251,300	7,590,620
Do. per cent.	8·89	11·08
Gas made per ton, cubic feet	10,958	10 893
Gas sold per ton, do.	9,984	9,686
Average illuminating power	19·17	19·11
Income from gas	£8325 1s. 9d.*	£8412 9s. 6d.
Do. from other sources	£2077 7s. 2d.	£2195 0s. 6d.
Average cost of gas made, per 1000 cubic feet.	1s. 3·12d.	1s. 3·98d.
Do. do. sold, do.	1s. 5·14d.	1s. 5·86d.
Average price of gas sold, do.	2s. 7·19d.	2s. 9·15d.
Gross profit per 1000 cubic feet of gas sold	1s. 2·05d.	1s. 3·29d.
Annuities do. do.	5·31d.	5·50d.
Interest on loans do. do.	4·80d.	5·11d.
Sinking fund do. do.	3·30d.	3·39d.

* Price of gas reduced.

BRADFORD CORPORATION GAS AND WATER FINANCES.

Mr. H. B. Ratcliffe, the Chairman of the Finance Committee of the Bradford Corporation, made his annual statement at last Tuesday's meeting; and in the course of it he gave some interesting statistics concerning the Gas and Water Departments. He said that his colleagues would all be aware that, in the past, the gas-works had been a very considerable source of revenue to the Corporation, and had resulted in large contributions being made towards relieving the rates. The net profits from the end of December, 1872, to the end of 1895 had amounted to £390,488. This was exclusive of the very large amount of money which had been expended in street lighting, and which, if the works had been in the hands of a private Company, would, of course, have been an enormous cost to the Corporation. Although the saving of this cost did not appear in the form of revenue, it was a profit which must be borne in mind. Of the figure which he had mentioned, £361,000 had gone to the relief of rates; leaving the accumulation of profits at the end of 1895 at £29,488. Turning to the Water Department, he said that the total borrowing powers for water-works purposes amounted to £3,761,900; and there had been actually borrowed £2,949,203—leaving unexhausted borrowing powers to the extent of £812,697. These figures included the new loans, amounting to £500,000, borrowed in 1894 for the Nidd Valley scheme. The expenditure up to the end of March last had been £317,788; and the Water Engineer estimated that up to March, 1897, it would be necessary to spend £114,000—making a total expenditure by the close of the next financial year of £431,788 on the Nidd scheme. This would leave a balance of only £68,212 to enable them to face the requirements of the year ending with March, 1898. In all probability, this would not be sufficient; and, therefore, before very long—perhaps early next year—they might seriously have to consider whether they would not have to go to the lending public again, to ask them for the loan of more money to carry on the Nidd scheme. In regard to the revenue of the water-works, he was pleased to be able to tell them that there was a very considerable increase in the income from water supplied by meter during last year. The advance amounted to the respectable total of £9609, chiefly accounted for by the increased prosperity of the staple industries of the town. But to set against this, was the very potent fact that the Water Committee had to face every year the interest on the £500,000 borrowed for new works, which reached no less a sum than £15,000 a year. This was a new charge arising within the last eighteen months; and they had also to contribute for sinking-fund purposes £8333; making a total liability every year on account of new loans of £23,333. Last year a very large amount of money was invested, and was bringing in interest; but when it was expended, it would for a considerable time give them no return at all. Nearly £9000 of interest would be lost in this way. Before eighteen months were over, the whole of the money now invested would be expended; and, besides this loss, they would be face to face with the additional burden of £23,333. He thought it was a healthy sign of the elasticity of the water-works system that, after taking into account all these increased charges and heavy burdens, there was only a net loss of income as against expenditure of £11,492. The amount which the Water Committee had to meet year by year for the whole of their interest and sinking fund came to no less than £126,000. It had struck him, and he had had some talk with certain of the officials about it, that the time had arrived when some very strong effort should be made, especially with reference to the new water-works, to see if they could not get Parliament to sanction a suspension of the sinking-fund until the new works became revenue-producing undertakings. If the new works were being properly constructed (as the Council had every reason to believe they were), they would be a most valuable asset for long after the termination of the sixty years; and it seemed to him that the burden should be distributed in accordance with these circumstances.

ELECTRIC LIGHTING NOTES.

The function of laying the foundation-stones of the Bradford Corporation new electricity works was performed last Friday week by Messrs. W. C. Dixon and T. Speight, who respectively occupy the offices of Chairman and Deputy-Chairman of the Gas and Electricity Supply Committee, and to each of whom was handed a silver trowel and mallet. The works are being erected on a site in the Valley Road, which has been secured for £2500. The tenders accepted for the buildings amount to £11,588, and for the machinery to £17,593—the total expenditure being estimated at £31,368. During the proceedings, the Mayor (Alderman W. W. Wood) claimed for the Corporation the distinction of being the first municipal authority to set up an installation of electric lighting, and asserted that the success which had attended their efforts had led others to experiment in the same direction. It was seven years since the first station was opened; and they started with but three engines, three boilers, and 10 miles of cable. In the first year of the venture, the financial statement showed a loss of only £1250. At the end of the second year, it was £490; and during the third year, they had a profit of £1385. That was satisfactory; and he was pleased to say that, from an estimate made, it would appear that the profit during this year would be something like £3280. Their existing plant consisted of seven large boilers, eleven engines with over 2100-horse power, and 25 miles of cable. They had 402 customers; and the supply covered an area of one square mile. When the new installation was completed, however, they would be able to distribute current over 19 square miles. His Worship also mentioned the fact that, notwithstanding the development of the electric light, the consumption of gas had also progressed with the population. The event was subsequently celebrated by a dinner at the Town Hall.

In the course of a recent inquiry by Colonel J. O. Hasted at Brighton into an application by the Corporation for the sanction of the Local Government Board to the borrowing of £35,900 for electric lighting purposes, some statistics were given by Mr. W. P. Boxall (representing the applicants) as to the progress of the light in the borough. These showed that since March, 1892, to March last, the number of consumers had advanced from 110 to 1121; and the quantity of electricity showed a proportionate increase. The profits made in 1894 amounted to £4400, of which £3000 was placed to the reserve fund, and £1400 went in relief of rates. Upon that the price of electricity was materially lowered, causing a difference of £6000 in the returns; and yet in 1895 a profit of £1150 was made. But for the reduction in price, it would have been £7500. Replying to the Inspector, Mr. Arthur Wright stated that the charge for electricity was 7d. for the first hour and 3d. per unit afterwards. The average price obtained last year was under 4¾d. per unit, or lower than in any other town.

A Local Government Board inquiry has been held at Eccles with reference to the proposal of the Town Council to borrow £20,000 for carrying out an electric lighting scheme. The Inspector was Mr. G. W. Willcocks; and he was informed that the Manchester Edison-Swan Company had offered to construct the works for £13,792. Adding to this the tenders for buildings and an allowance for contingencies made the total £18,761. The borough is at present supplied with gas by the Salford Corporation, at a charge of 2s. 4d. per 1000 cubic feet; and there is a good deal of opposition to the contemplated electric-lighting installation. Owing to this, it was found necessary to adjourn the proceedings. During the interval which elapsed before the second day's inquiry, some correspondence passed between the Town Clerk (Mr. G. W. Bailey) and the Board of Trade. He asked, in consequence of the Council being equally divided upon the desirability or otherwise of carrying out the scheme, and the opposition shown to it by a considerable section of the ratepayers, that the revocation of the Provisional Order granted to the Council, which expired on June 8, be deferred for a period of three years. The Board stated in reply that they are willing to defer the revocation for twelve months.

The Morecambe District Council have given instructions for the preparation of the necessary plans, &c., for an installation of electric lighting, at an estimated cost of £25,000.

The Lincoln Town Council last Tuesday week resolved to make application to the Board of Trade for a Provisional Order to enable them to undertake the supply of electric lighting. The scheme which the Council have before them is estimated to cost £14,661.

A successful attempt to re-open the electric light question was made by the Progressives of the Newington Vestry last week, and a Special Committee was appointed "to consider the whole question of electric lighting." After the recent Board of Trade inquiry, this action cannot but be regarded as a clever strategical movement on behalf of the enthusiasts.

At last Thursday's meeting of the Lambeth Vestry, Mr. Hubbard moved that the resolution transferring the Vestry's Provisional Order to Mr. Sax be rescinded. This was defeated by 59 votes to 13; and a Committee "to confer with the Clerk in drawing up the agreement with Mr. Sax" was appointed.

Sowerby Bridge Gas-Works Extensions.—The Sowerby Bridge District Council have before them two schemes for the extension of the gas-works. One is supported by the Chairman (Mr. J. Greenwood), and some of the members of the Gas Committee, and is estimated to cost £3432; while the opponents are advocating one which it is calculated will cost £2221. It has been determined to call in an engineer to decide between the rival proposals.

A New Reservoir for Colne.—At a meeting of the Colne Town Council yesterday week the Water Committee stated that in consequence of the rapidly increasing population, the present water supply was altogether inadequate. They had therefore secured the services of Mr. G. H. Hill, of Manchester, as engineer in seeking for a new supply; and this had been found in the Wycollar Valley, three miles from Colne. A reservoir would be required, and it would cost £50,000. It was resolved that the Committee's action be confirmed, and that application for sanction to borrow the necessary money be made to the Local Government Board.

SOUTHWARK AND VAUXHALL WATER COMPANY.

The Half-Yearly General Meeting of this Company was held at the Office, Southwark Bridge Road, on Tuesday last—Alderman Sir H. E. KNIGHT presiding.

The SECRETARY (Mr. Montague Watts) read the advertisement calling the meeting; and the report of the Directors was taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, said they were not quite so much harassed as they were at this time last year; and it would therefore not be necessary for him to go so much into detail. On looking to the capital account, they would see that they had overspent their capital by £26,361; consequently the time had arrived when it was necessary for them to make the first issue of the capital which Parliament authorized by their Act of 1894. This capital had to be raised under somewhat different conditions to those which applied to the previous capital. It was still to be raised by debenture stock; but this stock was to be redeemable 25 years from the date of issue. Under their Act of Parliament, the rate of interest at which the issue was to be made was to be decided by the Governor of the Bank of England. This was settled by Parliament, after very great discussion before the Committee, with the idea that the Governor of the Bank should fix the interest at such a rate as would ensure the debenture stock being issued as nearly as possible at par. Consequently they were now about to take steps for putting themselves in order for making the necessary application to the Governor of the Bank of England, whose decision they would receive shortly. It was the intention of the Directors to issue £100,000 of this stock before the end of the current half year. Turning to the revenue account, he said it would not be necessary for him to deal with it so much in detail as he had done in previous half years, because they had a sort of disturbing element in it which they had not yet got rid of—that was, the element of expense consequent on the severe frost. If they looked at the total of the maintenance account, they would see that it stood at £53,384; while at the corresponding period of last year, the figures were £53,634. Both of these were abnormal amounts, and far greater than they would be under ordinary circumstances; but the excess was accounted for in each instance by the amount of money they had had to pay on account of the frost expenses. If they took the figures of £11,212 for maintenance and repair of mains, £14,045 for pumping and engine charges, £1758 for filtration, and £7000 for the portion of the frost expenditure brought from last account, the excess these figures showed above what the normal amount ought to be was fully £10,000. Pumping and engine charges were largely increased, owing to circumstances which did not always occur at one time at the beginning of exceptional circumstances. For instance, they had had to pump a considerable quantity of water more than they had expected, on account of the leakages caused by bursts owing to the frost, which could not all be discovered until after a long time; and then a great many of the pipes remained leaking because the consumers would not go to the expense of repairing them. These people had all to be found out by their officers; and then the leakages were stopped. They, however, extended over a long period; but they hoped and trusted that they had now come to an end of them. This waste caused not only extra pumping expenses, but also a considerably greater consumption of fuel, and an additional amount for wages. He mentioned this because he wished to impress upon them that no one really could have foreseen that these leakages would go on for such a long time. He thought they had now come to the end of them, however. They only carried forward now to suspense a sum of £3000, and £2667 for the lowering of mains, also consequent on the frost. They did not fancy that there were any other accounts of any consequence, or any further expense to be incurred; and they thought they might take it for granted that the expenses of the frost were covered by the £33,000 they had paid, or would pay in the course of the next few months. He thought it spoke volumes for the strength, stability, and prosperity of their undertaking that they had been able, by sacrificing £20,000 out of their own pockets, which they would have received as dividends, and by finding the other £13,000 out of surplus profits, to meet such an exceptional state of affairs. They had an eminently prosperous concern; and it did not derogate from their position, or from the value of their undertaking, because under these circumstances they had been obliged to accept a 4 per cent. dividend, instead of the larger amount to which they had been accustomed. The charges for management were almost the same as in the corresponding period of last year. There was an excess of £600 under the head of stationery, printing, and general establishment charges. This was caused, to some extent, by the quinquennial valuation. The cost of obtaining the quinquennial valuations had been no less than £300; but it was absolutely necessary for them to have them, in order to regulate their future charges. There was also a sum of between £200 and £300 for which they paid for an insurance policy against losses from accidents. He had now something very satisfactory to draw their attention to, on the other side of the account. The amount of water-rents accrued to the date of the accounts was £116,692; whereas at the corresponding period of last year, it was £113,377. They had therefore this half year an increase in their revenue of £3,315. He should, however, like to take them back to the half year ended Sept. 30, 1895, when their water-rents accrued amounted to £122,396, and compare that with the amount in the corresponding period of 1894, when the figures were £118,821—showing an increase of £3575. Adding this £3575 to the £3315, they had a grand total of £6890 in their revenue for the year. This was a highly satisfactory position. It spoke volumes as to the success of their undertaking, its importance, and value; and it was the best and most satisfactory answer they could give, combined with the extraordinary expenses on the other side of the account, as the reason why they had had to descend to a dividend of 4 per cent. per annum this half year. But for these circumstances, which were beyond their control, the Company would have been in such a state of prosperity that they could have paid 6½ instead of 4 per cent. In the dividend and interest account for the half year, they had a balance of £20,634 applicable to dividend. In their report, they had stated how this amount had been obtained; and the Government Auditor had approved of the recommendation of the Board. He thought it would have been almost a misrepresentation of the position of their undertaking, if they had paid a less dividend than 4 per cent., because people might have inferred, had they done so, that they were not in the high state of prosperity which they really enjoyed. They said last half year that they thought they saw their way clearly to paying off the amount carried to suspense on account of the frost, and still to pay a 4 per cent. dividend. They had been rather disappointed in this expectation; but at the same time he maintained that they were thoroughly justified, and that the Government Auditor was also justified in allowing £3000 still to remain in suspense, thus enabling them to pay the dividend they expected to be able to pay. In paragraph 2 of the report, they dealt with the increased annual rent of £1500 from new houses. This was only the increased rental from the new houses they supplied; but they had an increase going on continually on account of extra meter-rents and other branches of their business which brought in a profit. Therefore, although the profit from the new houses was £1500 for the six months, yet the increased revenue from other sources in the half year was £1800 in addition; and these two amounts together made up the £3315 to which he had called attention. They would, he was sure, have been pleased to hear that the iniquitous eight Bills promoted by the London County Council against the Water Companies were, by the wisdom of Parliament, quashed. It was astounding to him how any body of men could have persisted in a course which he could only describe as thoroughly iniquitous, and one which was utterly unnecessary. One Bill would have done the duty of the eight; but it was to make the eight-fold expense fall on the Water Companies, and it could have been for no other object than to keep up that harassing and constant worry which had all along been the policy of the London County Council against the Water Companies. Parliament, however, would not allow these Bills to proceed; and they were thus saved from the enormous additional cost which they would otherwise have been put to. They would in that case have had to go to the same expense as last time, which he believed was £4000; and no earthly good could have arisen from the outlay. For all the cost which had been inflicted on the Companies—amounting to about a quarter of a million, with the expense incurred by the London County Council themselves—and all the money which that body had wasted since they had been in existence, there was nothing whatever to show. The Government had introduced the Metropolitan Counties Water Board Bill; and it had passed through Committee in the House of Lords. He could hardly discuss it while it was *sub judice;* but he might say that they were watching it closely. There were some things in the Bill which they thought ought to be altered; and they had every confidence that it would emerge from the House of Commons Committee with those alterations and amendments which should be introduced into it to make it a valuable and successful measure. They would remember that another scheme of the London County Council to harass the Companies and waste the public money was a proposal that the two-gallon flush to sanitary conveniences, which had been found amply sufficient for a great many years, should be raised to three gallons, because by that means they would increase the quantity of water to be supplied by the Companies by some 5 or 6 million gallons per annum. This would have put them to a considerable expense in other ways. They had had to bear the brunt of that inquiry—to face it, and to get up evidence in order to place before the Commissioner the whole facts of the case, and assist him to come to a right and proper decision. The Companies proceeded to do this in a most thorough manner; but it was not done without large expense. It cost the Companies between £2000 and £3000, of which their own share was between £300 and £400 at the very least. The result was what they had foreseen perfectly well—Colonel Ducat refused to entertain the proposal for a moment. The evidence was overwhelming that the two-gallon flush was amply sufficient; and not one of the recommendations or ideas of the London County Council was permitted to become law, or even to receive any sanction or approval whatever. The Companies, however, had all the worry; and their attention had been taken from their own business to defend their interest against this attack, and they had also had to pay the heavy bill which followed. The Company had been trying, as they would remember, and as they informed the Royal Commission they would do, to obtain auxiliary supplies of water from wells. Years ago he used to talk to them about the Streatham well, which had been in operation for some time, and had answered their expectations most thoroughly. In fact, they had prospects that it would give them a large supply beyond what they at first anticipated. With this in view, and the information they obtained from men who understood these questions, they had proceeded further in the same direction, which was approved by the Royal Commission; and, as stated in their report, they had acquired two other sites on which they had proceeded to make trial borings. These fresh sites were in the neighbourhood of Wimbledon and Merton, where they believed there was a very large supply of water to be obtained from wells. One of these trial borings had got down as low as 153 feet; and the other boring, which they commenced recently, had got down 45 feet. They would have to go through the upper strata of about 220 feet before they came to the chalk. They had got down 153 feet; and were bringing up a sort of clay conglomerate, which was very attractive in appearance, because there was something in it which looked uncommonly like silver. He did not, however, imagine that they were going to drop on a silver mine; but if it did come in their way they should not refuse to make the best of it. He had no doubt that, before their next meeting, they would be able to ascertain the quantity of water they might look forward to obtaining from these two wells. They thought the matter of this auxiliary supply was so important that, in their Bill now before Parliament, they were trying to get permission to sink a well at Harefield, where, geologists told them, there would be no difficulty in getting a large supply of water of magnificent quality. They had proceeded steadily with the works they undertook to construct under their Act of 1894. They had completed the Sunnyside reservoir, which gave them a capacity of about 90 million gallons, and which had cost them about £70,000. The time, however, which these works took to construct was really serious. They commenced this reservoir in 1891; it was, in 1896, only just completed. This was a fact which necessitated their looking a long way ahead, if they were to keep in touch with their requirements;

and it did not do to go to Parliament only two or three years before they required something. He thought that, if there was anything they were likely to want in ten years' time, it was very urgent to get the consent of Parliament to it at once. They had entered into a contract for the construction of a large reservoir on the Staines Hill site; and this was proceeding well. Every energy was being used to push the work forward, as it was very urgent that they should get more storage. They had also entered into contracts for the construction of an engine-house and engines. The price of the engine house would be £24,000, and of the engines £38,000. They have laid a 4 ft. 6 in. main to connect their storage reservoir with their filter-beds. What they stated in the last paragraph of the report, which related to the dividend, was after very careful consideration, and using the very best judgment they possessed. Next half year he sincerely trusted that they would be enabled to carry out what they had in their minds—that was, that they should be able to return to their 6 per cent. dividend and able to wipe off those amounts which now remained in suspense. They thought they saw their way to doing this, if they had the same increase in their income as last year, and if they had no more extraordinary charges to meet. Law expenses this half year did not look as if they would be anything serious; but those connected with their Bill would, of course, be considerable. They were, however, a capital charge; and he had not the least reason to doubt but that the Bill which they were promoting would in due course receive the approbation of Parliament and the Royal Assent, for he could not imagine a greater condition of urgency than that which existed in the case of their Company for providing these extra works.

Mr. C. M. VIALLS seconded the motion.

Mr. W. B. JEFFERIES thought that the bad debts ought to be reduced to £500 in the half year; and he believed that this might be done. He thought the value of the property was being materially increased by lowering the mains; and he considered that a portion of the expenditure thus incurred ought to be charged to capital account. He trusted that, as the Chairman had said, they might return next half year to their old dividend.

The CHAIRMAN, in reply, stated that a portion of the cost of lowering the mains was charged to capital. As to bad debts, they were only £550 last half year, which was very small out of their revenue of £116,000. Some of their collectors got in $99\frac{7}{10}$ per cent. of the amount they should collect. In further reply to Mr. Cooper and Mr. H. L. Phillips, the Chairman stated that the September half was always their best half year, as they derived income from road-watering and other sources. Some delay did take place in connection with the sinking of the Streatham well, on account of the requirements of the Government Inspector in connection with the question of surface water getting into the well; but he did not think that they would incur any revenue loss from this.

The resolution was then put, and carried unanimously; and the various dividends recommended were subsequently approved.

Mr. JEFFERIES afterwards proposed, and Mr. PHILLIPS seconded, a vote of thanks to the Chairman and Directors; and the motion was carried unanimously.

The CHAIRMAN, in acknowledging the vote, remarked that if they had only had fair treatment during the last few years, they would now be nearer to their maximum dividend, and the public and the proprietors would have been benefited. He was sure that it was intended to include in the vote the Company's officers, who always worked so zealously.

The proceedings then terminated.

GRAND JUNCTION WATER-WORKS COMPANY.

The Half-Yearly General Assembly of this Company was held at the Offices, South Molton Street, last Wednesday, under the presidency of Mr. FREDERICK TENDRON.

The SECRETARY (Mr. J. Goodwin) having read the notice calling the meeting,

The CHAIRMAN proposed the adoption of the report and accounts. He observed that the entry in the revenue account which must have most interested them was that under the heading of "Special expenditure," the first item of which was one they had been prepared for—the proportion of the cost debited to the half-year's revenue for lowering mains. After much consideration and consultation with the Government Auditor, it was decided to charge one-third of the cost of this work to capital, and the other two-thirds to revenue. They felt that it was not fair to the shareholders to charge the whole amount in a single half year; and they had therefore only debited one moiety in the accounts submitted to them, while the other half would appear in the accounts next September. The work was still going on; and if the accounts were favourable, and they could maintain the dividend which they would propose that day, they would put in a further amount for the lowering of the mains. Now, however, that they had raised the dividend from what it was last year, they would certainly not go back if they could possibly help it. They felt that the shareholders had a very heavy burden to bear last year, when no less than £20,000 of exceptional expenditure went against the accounts; and now, with some bitterness, they must have noticed the second item under the head of "Special expenditure"—parliamentary expenses, £1911—and might well wonder what they had got in return. This was outlay which had been forced on them by the London County Council, in opposing that body's Purchase Bills, which, however, had now been got rid of. There was a small additional amount of expenditure still to come in on this account; but it would only amount to a few hundred pounds. This was why he had said that, if things went well with them, they would probably be able to put a larger amount to the cost of lowering the mains. It was very important that if possible they should avoid any recurrence of the serious loss and inconvenience which arose from the exceptional frost of last year. It was a frost which had not been equalled for 30 years; but it would not do to act on the assumption that another like period would elapse before they had a similar experience. This would explain why in the suspense account, on the credit side of the balance-sheet, they had an amount carried forward of £3337 for lowering mains. The next entry in the suspense account was for the Staines Reservoirs Bill—the payment they had to make on account of parliamentary charges for this Bill. They had probably read in "The Times" of that day a report of what occurred before the Hybrid Committee, the Chairman of which had given the Companies' representatives clearly to understand that they would insist upon clauses being introduced into the Bill binding them to a sinking fund. This was a very serious matter. They had undertaken the Staines scheme really, as they had done their work throughout, with a desire to benefit their shareholders by serving the public; and in connection with this great work, which they were seeking to undertake with the New River and the West Middlesex Companies, they had had rather a painful experience in finding what an occasion it had been for seeking to get money out of them. They had not only had to meet the ordinary charges, which they had expected to bear; but the Thames Conservancy had asked them for more, and they were given to understand that a heavy charge would be imposed on them in the future—for whose benefit, it was difficult to say. The subject was, however, receiving full consideration; and they would go on with the Bill, because they thought it most important that any failure to obtain it should arise from the action of others, and not from that of the Companies concerned. Another item carried forward against suspense account was "deposit and costs *re* assessment repeals." This was the quinquennial year; and some of the parishes had been so unmerciful in their rating, that the Directors had found it necessary to fight them. What the consequence of these increased rates had been to them, they might judge from a fact which he would mention. During the past ten years, they had expended on capital account over £240,000; the bulk of this outlay having been to improve the quality of the supply, and to ensure that under no circumstances avoidable on the part of the Company should the people run the risk of going without water. They had built large reservoirs, increased the area of their filter-beds, and duplicated mains. During the ten years, their rental had increased, comparing the half year under review with that of the corresponding period ten years ago, by £12,400; and deducting ordinary working expenses, a balance remained of £6700, which would be a very fair return for the money they had spent. Nearly the whole of it, however, had gone in additional rates and taxes. The taxes increased enormously at every quinquennial assessment, without corresponding advantage to them in the water-rental; and this showed clearly the tendency of the present day to make the Companies pay, wherever they could, an undue proportion of the rates. This was not very encouraging to them, when they intended selling that day 800 of their £50 7 per cent. "D" shares. They did not know what price these shares would realize; but he thought he was only modest in expecting that they would fetch £100 each. This further capital meant additional interest which they would have to pay; and they naturally tried to keep the charges down as much as possible. Therefore, whatever the result of the appeals in question might be, they felt that they were only doing their duty in fighting the parishes which sought to impose on them unreasonable additional amounts. The increased capital they were going to raise by the sale of shares that day, they did not expect so much to bring them in returns at the present time. What they principally had in view was the statement made in the report of their Engineering Director—that what they contemplated doing would ensure a full supply to their district, and without the danger of any breakdown, for the next five years. They were going to duplicate certain mains—especially a large main of some $4\frac{1}{2}$ miles in length, which had to bear the great pressure of water in the very hot season, or when they were pumping very largely. They were also going to increase the area of their filter-beds, and to construct supplementary engines, so that, if an engine broke down, people should not be without water. The whole of the £80,000 which they expected to receive from the sale of the shares referred to would really go in these works; and when they were carried out, they might feel comfortable in their minds, so far as expenditure was concerned, for some years. The pressure of the proposed expenditure would be more heavy on them at the beginning than it would be afterwards. They would obtain some return from the increased outlay in their district; but at first this would not affect them much. It was of no use dragging the projected works out slowly, because, as the interest would begin from the time when they got the money, the sooner the works were completed the better. He asked them to judge as shareholders, and he would also ask the consumers to do the same, whether, under any public authority, anything more could be done to keep things in perfect order than was done by the Company, who fully desired to perform the duty they had undertaken towards the public. With regard to the Government Bill, it was not very long; but there were some most objectionable clauses in it. Its worst features had been pointed out to them by their esteemed colleague Viscount Knutsford, who had done his best in the House of Lords to get them amended; and the Water Companies conjointly would also do their best to get the objectionable parts altered. The worst clause of all was that which gave the Water Board—who were to be prospective purchasers of the undertakings—the power of backing up any individual to bring heavy costs on the Water Companies. It seemed monstrous that they should be buyers with the one hand, and with the other should be able to press people forward to do that which would depreciate what they sought to purchase. If they were sure that the Water Board would only consist of experienced and right-meaning men, it would be a different matter; but when they saw that no fewer than 16 out of the 30 members of the Board were to be elected by the London County Council—of whose dealings they had had much experience—they felt that the spirit of equity of Parliament should be evoked, to prevent such an abuse being perpetrated. He had never yet seen a measure brought forward for the public good which, if projected by a Water Company, or out of which a Water Company might make any profit, the London County Council had not opposed—even to the sacrifice of the interests of their own constituents. He felt sure they would all hear with regret of the death, a few days ago, of their late Secretary (Mr. Coe), who died at the advanced age of 88.

The Right Hon. Viscount KNUTSFORD, in seconding the motion, remarked that the Chairman had fully stated the position of the Com-

pany. With regard to the Metropolitan Counties Water Board, which passed through Committee of the House of Lords on the previous day, though Lord James of Hereford was not very ready to make many concessions, he had struck out, at his (the speaker's) desire, certain words in section 4 of clause 4. The section read as follows: "The Water Board may aid any inhabitant of the Metropolitan water area in obtaining the determination of any question which appears to the Board to be of general interest to consumers of water, or to any class of such consumers," &c. He had ventured to point out to Lord James that a question might arise with the words as they stood as to the supply of water in a cistern, or that some question affecting a cistern might be raised. This would apply, no doubt, to a certain class, but to a very decreasing class, of consumers. The Grand Junction Company gave a constant supply altogether; and all the Companies, in obedience to the desire of the Local Government Board, were also giving a constant instead of an intermittent supply. The question of cisterns would therefore not affect the large and increasing majority of water consumers; and he therefore suggested that the words "or to any class of such consumers" should be struck out, as they did not affect the interest of the consumers as a body. The Bill also provided that the London County Council were to appoint 16 members of the Water Board, and that one-third should retire every year; but it was not provided sufficiently strictly that the whole of the first 16 members appointed by the County Council should retire one-third every year. Therefore Lord James had put in the words "by rotation." He was afraid that these alterations formed all that he could screw out of Lord James of Hereford; but the Bill was now to go to the House of Commons, where the Companies might possibly be more fortunate.

Dr. LEESON felt sure that the interest of the proprietors was being thoroughly well looked after by the Directors, though they were so continually attacked; and he also thought they might rest assured that all the money that had been expended in protecting their property had been thoroughly well spent. It was most important that they should get their mains lowered, and that they should give as good a supply as possible. He expressed great regret at the death of Mr. Alfred Fraser, who had served the Company for many years.

The motion was unanimously adopted; and resolutions were afterwards passed declaring a dividend at the rate of 7¼ per cent. per annum on the ordinary share capital, and re-electing the retiring Directors (Mr. W. Harrison, Mr. W. Hunter, and Mr. H. Mott) and Auditor (Mr. R. A. M'Lean).

On the motion of Sir J. SEBAG MONTEFIORE, seconded by Mr. H. BARNAUD, a cordial vote of thanks was passed to the Chairman and Directors.

The CHAIRMAN briefly replied; and the proceedings then terminated.

NOTTINGHAM CORPORATION WATER SCHEME.

Decision of the Local Government Board.

The Local Government Board have pronounced their decision in regard to the application of the Nottingham Corporation for a Provisional Order to authorize the extension of the limits and their area of water supply; and it is unfavourable to the applicants. It will be remembered that the Corporation proposals gave rise to a great deal of opposition, and consequently to a long inquiry by two Inspectors of the Board (Colonel J. O. Hasted and Mr. E. P. Burd), as reported in the "JOURNAL" in April last. The letter communicating the decision of the Board commenced by referring to the intention of the Corporation to extend their present limits of water supply by the inclusion therein of various parishes in the Basford, Southwell, and Bingham rural districts, and then proceeded: "As the Town Council are aware, the application to include the majority of these parishes within the limits of supply of the Corporation is strongly opposed by the Nottingham County Council, the Corporations of Mansfield and Newark, the Urban District Councils of Sutton-in-Ashfield and Hucknall Torkard, and the Southwell Rural District Council, so far as the inclusion of Epperstone is concerned, and also by several landowners. It appears from the agreement made on the 28th of March last, between the Town Council and the Rural District Council of Basford, that the Town Council are not to supply the parishes of Calverton, Woodborough, and Lambley with water, until they are supplying water to the Borough of Nottingham from the proposed new pumping-station at Grimesmoor, and that the agreement is only to be binding on the parties to it in the event of the Corporation obtaining power to get an additional supply of water from Grimesmoor by Provisional Order or otherwise. It would appear, therefore, that if these parishes were now included in the limits of supply, they would not be supplied by the Corporation for some time to come, and that in the event of the Corporation not obtaining power to get an additional supply of water from Grimesmoor by Provisional Order or otherwise, the inclusion of these parishes in the limits of supply might impede rather than expedite the supply of water to them, having regard to the provisions contained in section 52 of the Public Health Act, 1875. The application of the Town Council to include these parishes in their limits of supply is, therefore, in the opinion of the Board at present premature. The Board under these circumstances are not at present prepared to make an Order including such parishes in the limits of supply of the Corporation. It appears to the Board that the additional supply which is contemplated is intended to be obtained primarily for the purpose of supplying the borough with water; and the Board consider that the question of extending the limits of supply should be deferred until the further supply referred to has been obtained. If, as is contemplated by the last clause of the agreement of the 28th of March last, additional statutory powers are required for obtaining this supply, it appears to the Board that the question of the extension of limits should be dealt with by the Bill, by which it may be proposed that those powers should be acquired. The only exception which the Board are prepared to make are with regard to the township of Burton Joyce and the parish of Radcliffe-on-Trent, the inclusion of which within the limits of supply was not, as the Board understand, opposed at the inquiry. The Board will be prepared to extend the limits to include these places on the understanding that, when the Order is confirmed, the Corporation will proceed forthwith to furnish a supply to these places."

WOLVERHAMPTON CORPORATION WATER SCHEME.

Local Government Board Inquiry.

On the 5th inst., Colonel J. O. Hasted held an inquiry at Wolverhampton, regarding an application by the Corporation to the Local Government Board for a Provisional Order to partially repeal, alter, or amend certain Local Acts, so as to enable them to purchase land for water-works purposes at Penn and Wombourn; to sink wells and construct works; to borrow money; to carry into effect agreements with the Staffordshire and Worcestershire Canal Company and Lord Wrottesley in connection with the undertaking; and, further, to execute compensation works if required. The Town Clerk (Mr. H. Brevitt) represented the Corporation; and Mr. Plumptre opposed on behalf of the Seisdon District Council and the Board of Guardians. At the outset, Mr. Plumptre stated that the reason the Seisdon Council did not appear before was that they did not know the new works would be on a site that would in any way affect them. The Town Clerk remarked that the Local Government Board were prepared to issue the Order, and had sent a copy of it; they being doubtless unaware there would be opposition of any sort. The Seisdon Council were not the water authority, and had not the power to supply water; but the Corporation were prepared to furnish it. In this matter, the Seisdon Authority had no *locus standi*. They were fighting the matter with Bilston; but with that the Corporation had nothing to do. As to the scheme, when the Inspector held the last inquiry £17,000 was the sum he (the Town Clerk) mentioned as the cost of the scheme; but events had transpired necessitating an increase. Mr. E. A. B. Woodward, the Water Engineer, gave evidence of the boring operations that had taken place at Dimingsdale. He said they had gone down to a depth of 240 feet, the first 42 feet of which was absolutely dry. The water now stood at 25 feet from the surface. He estimated the cost of the well-sinking and boring at £5500; providing an 18-inch rising-main and extending over three miles, £7500; boilers and pumps, £7000; buildings, workmen's dwellings, &c., £7000; coal hauling and storing appliances, £1000; purchase of land, tenants' rights, and trial borings, £1500; compensation, £3000; contingencies, £2500—making a total of £35,000 as the estimated cost of the entire scheme. From Bilston they would receive £13,250. Replying to Mr. Plumptre, witness said he adhered to the opinion that the pumping would do no harm to the Canal Company or to Lord Wrottesley. Mr. C. E. De Rance said the site chosen was, he believed, a water-bearing stratum sufficient to yield a good and sufficient supply for Bilston as well as Wolverhampton. There were 14 square miles of new red sandstone, which he estimated would yield a daily average of 5,600,000 gallons of water. Mr. Plumptre argued that the humble communities of Orton and Seisdon had a right to raise their voices in order to protect the interests they could not afford to lose. At the present time they were in possession of a water supply which had always been sufficient down to recent times; but they apprehended that, if this scheme was carried out, their districts would be deprived of a water supply through the pumping operations of the Corporation. Mr. E. D. Marten, a civil engineer, was called by Mr. Plumptre, and said the pumping-station would have a serious effect on all the local wells. It was a matter of common knowledge that the Cosford pumping-station had already affected the local wells, and the pumping at the Bilston station at the Bratch had had bad effects on a well 1¾ miles away. Fifty-six wells had been affected by this particular station. He considered the radius of 1¾ miles for a protected area was a reasonable one, considering the circumstances that had come to his knowledge. The inquiry, which lasted five hours, then terminated.

UNSATISFACTORY CONDITION OF THE ROTHERHAM WATER SUPPLY.

According to the annual report of Dr. Robinson, the Medical Officer of Health for the borough of Rotherham, a condition of things exists in connection with the water supply which demands immediate investigation and remedy. Both as regards quantity and quality, he considers the supply unsatisfactory. His report includes a lengthy statement on the Ulley and Dalton water supplies; and, in regard to them, he deals individually with several sources of pollution—including drainage from houses and farmyards, manure heaps and residuals from gas-works, and cesspools. Speaking of the Dalton supply, Dr. Robinson mentions that, accompanied by the Mayor, Mr. F. Mason (a member of the Town Council), Dr. Whitelegge (county medical officer), and the Sanitary Inspector, he visited, on April 26, some of the places where these pollutions occur; and in one instance human excrement was found trickling from a privy into the stream from which the supply is derived. The springs at Pinch Mill and Aldwarke are satisfactory; but the water is not filtered. Dr. Robinson says he cannot too strongly impress upon the Corporation his strong sense of the dangerous condition of the water supplies of the town, resulting from the present seriously polluted state. He earnestly urges that immediate and stringent measures be taken to enforce the powers the Corporation possess to remove such pollution; and he also suggests that arrangements be made, as far as possible, for grassing the land in the immediate vicinity of the feeders. An analysis of the water, made by Mr. A. H. Allen, of Sheffield, gives results indicating infiltration of drainage from cultivated land or similar source, but showing the water in its present condition to be satisfactorily free from traces of readily changeable organic matter.

Increased Storage at Dorchester.—The Dorchester Gas Company have decided on the erection of a new 80-feet gasholder and masonry tank, designed by Mr. Henry Willey, of Exeter.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The transfer of the Dunfermline Gaslight Company's undertaking to the Town Council, is proceeding apace. It is after all to be settled by arbitration. As a preliminary, the parties have agreed that not more than three experts are to be called on each side. The Town Council are to retain the services of Mr. W. Foulis, of Glasgow, as Arbitrator on their side; and their principal witnesses will be Mr. F. T. C. Linton, of Leith, Mr. Charles Hunt, of Birmingham, and another English authority. The witnesses on the other side are not announced. It is expected that the reference will take place in Edinburgh about the end of next month.

The Perth Gas Commission held their annual meeting on Monday, at which the accounts for the past year, and the estimates for the current year, were submitted. Bailie Wright, the Convener of the Works Committee, said that, as in the preceding year, an enormous increase had taken place in the manufacture of gas. They had estimated that 98½ million cubic feet of gas would be sold; but they had sold 2 millions more—the larger portion of this increase being derived from the consumption of gas for cooking and motive power. The number of new meters put on far exceeded the record for any previous year; thus preparing for a still greater increase in the demand for gas. The bad debts on the collection of £17,000 during 1894 amounted to £39; and on £18,125 during 1895, they were only £32. This reflected the greatest credit on the whole of the Treasurer's department, and especially on Mr. Lindsay, the Treasurer. A rather unsatisfactory feature in the year's working was the amount of leakage, or unaccounted-for gas—viz., 10·64 per cent. Only on two previous occasions had this been exceeded; but the Gas Engineer (Mr. Wilson) hoped to have the item considerably reduced during the present year. The average illuminating power of the gas had been 26·62 candles. About 10,600 tons of coal and 606 tons of oil had been carbonized during the year; producing 9703 and 20,198 cubic feet of gas per ton respectively. From the sale of gas this year, they expected to get £18,000; from naphtha and ammonia, £500; from tar, £800; and from coke, £1300. Secondary products thus gave £2692—an increase of about £200 on last year. From the expected revenue, the meter-rents had disappeared; and a much-needed and long-requested concession had been made to the gas consumer. By the abolition of meter-rents—which two years ago amounted to £660—a capital sum, when computed at the present rate of money, amounting to nearly £20,000, had been handed over to the community. The total estimated expenditure, including an expected balance of £141, was £20,824. The report was adopted; and the price of gas was retained at 3s. 6d. per 1000 cubic feet within the city, and 3s. 11d. in Scone.

At the same meeting of the Commission, Bailie Wright explained that he and Mr. A. Wilson, the Manager, had, along with the Inspector of Cleansing and the Burgh Surveyor, visited the Nether Friarton Farm, so as to be able to recommend a new site for the gas-works; and that they had selected a site between the manure depot and the railway. It was remitted to Mr. Wilson to report his views on the proposed site.

The Broughty Ferry Police Commission on Monday approved of the following contracts for the current year: 1000 tons Bannockburn washed treble nuts, at 9s. 1d. per ton; 1500 to 2000 tons Kelty dry screened treble nuts, at 8s. 9d. per ton; 500 to 1000 tons Blairhall washed treble nuts, at 9s. per ton; and 150 to 250 tons of oil, at £2 17s. 6d. per ton. Provided that the Manager (Mr. A. Waddell) is satisfied as to its efficiency and value, a contract will also be entered into for a supply of from 50 to 150 tons of blast-furnace oil. The cheap quality of coal which has been contracted for shows the capabilities of the oil process. But for it, Mr. Waddell would not have been able to work with only nuts; he would have required a large admixture of coal at double the price. It will be observed that oil at £2 17s. 6d. per ton is nearly one-third dearer than Mr. Linton's estimates were founded on in his famous report of April, 1893, when he calculated it at £2 per ton. But it will be remembered that he then said that oil might rise to £4 per ton, when oil gas would still be cheaper than gas from high-class cannels at the lowest prices at which they had ever been sold—which were from 12s. per ton for Pirnie to 18s. per ton for Arniston and Newbattle cannel. Newbattle cannel is at present being delivered at Leith at 18s. 3d. per ton; so that, on the one hand, it is very nearly as cheap as it ever was, and, on the other, there is still a considerable margin of profit to be made upon the use of oil gas.

The Rothesay Town Council have contracted for 4600 tons of coal for the gas-works, at an average price of 12s. 9½d. per ton, as compared with 12s. 11d. per ton last year, delivery to be at the port.

The Port-Glasgow Town Council have contracted for the following coal for the gas-works: 800 tons Belfield cannel; 800 tons Dalquhander cannel; 700 tons Milton gas coal; 500 tons Udston splint; 200 tons Drumpellier splint; and 500 tons Meiklehill gas coal—a total of 3500 tons, at an average price of 10s. 10d. per ton.

The Kinross Gas Company have paid a dividend for the past year at the rate of 6 per cent., in addition to wiping out a debt of £100 upon the Company. The price of gas has been continued at 5s. per 1000 cubic feet. The Largs Gas Company have paid a dividend at the rate of 6 per cent. The Stonehouse, Lanarkshire, Gaslight Company had last year the largest sale of gas of any year since the Company was formed. They have paid a dividend at the rate of 5 per cent., and have reduced the price of gas from 5s. to 4s. 7d. per 1000 cubic feet. The Stevenston, Ayrshire, Gaslight Company have paid a dividend at the rate of 5 per cent., and have retained the price of gas at 5s. 10d. per 1000 cbuic feet.

Professor A. B. W. Kennedy, the Consulting Engineer to the Electrical Department of the Corporation of Edinburgh, has reported as follows to the Town Council: "The station opened on April 11 last year with about 2000 lamps on circuit. On May 15, therefore—that is, at the end of your financial year—the station will have been running for 57 weeks. The number of lamps actually connected to the mains is now 51,900, besides 247 arc lamps, equivalent to about 4500 incandescent; making the total number of lamps connected equivalent to 56,400 lamps of 8-candle power. The number of private consumers connected to the mains of the Corporation is 445; in April, 1895, it was 48. I am extremely glad to be able to say that the financial success of the enterprise has corresponded to the great demand for light. The accounts are not, of course, as yet made out to May 15; but the final weekly reports allow us to estimate all the figures very closely. The total income from incandescent lighting, allowing for meter-rents, and after deducting all rebates, will be about £13,300. The total income from arc lighting will be about £3500; making in all an income of about £16,800, or possibly a little more. The total station expenses, including all expenses in trimming arc lamps and supplying carbons, and in maintenance of mains, &c., have been about £4500. Standing charges, as stated by the Town Clerk, including interest and sinking fund, and also including general charges against the department, amount to about £9450; making altogether £14,000, and therefore leaving a net profit balance of £2800. Out of this balance, allowance has to be made for depreciation; and I have given this matter very careful consideration. I understand that your sinking fund amounts to 3⅓ per cent. per annum—that is to say, that you put by, on account of sinking fund, 1-30th of your whole capital expenditure every year. Under these circumstances, I do not think it is necessary that you should make any special further depreciation allowance on any items of expenditure which will last for 30 years—that is to say, on which you would not naturally put a higher rate of depreciation than 3⅓ per cent. I think that you may consider that all buildings, mains, road-work, and lamp-posts come under this head; and that, therefore, on these items you need not allow any further amount of depreciation. On plant, however, of every kind, it would be well that you should allow a total of 5 per cent. for depreciation—or, say, 2 per cent. in addition to what is allowed in the sinking fund. I believe this amount would run on £24,064 of your expenditure, and would therefore involve an additional allowance of £480. On batteries, instruments, arc lamps, meters, transformers, rectifiers, and one or two other matters, on which you have in all expended the sum of £7850, I think it would be advisable to allow a total depreciation of 10 per cent.—or, say, 7 per cent. more than you have already allowed. This would require an additional amount of £550 altogether; so that you would require a total allowance, in addition to the sinking fund, of, say, £1030 for depreciation. This will still leave you a clear balance of from £1700 to £1800. I do not attempt to put the figures more exactly than this, because the accounts are not yet made up. The total number of units sold during the 57 weeks from the start until May 15 have been about 560,000 to private consumers, and 328,000 for street lighting—in all about 888,000. Your actual works' cost per unit will, at this rate, be under 1·25d. per unit, including lamp trimming and carbons; and if this figure is reached, it will be the lowest yet obtained in the country."

The new reservoir at Craigmaddie, which has been under construction by the Glasgow Corporation for the past 12 years, was formally opened on Thursday; ex-Bailie Osborne, the Convener of the Water Committee, turning on the water into the reservoir. The reservoir has a water surface of 86½ acres, and an available depth, for the supply of the city, of 40 feet; and at this depth it will contain 700 million gallons. The Mugdock reservoir, which immediately adjoins, has a water surface of 60 acres; and, at the same available depth, has a capacity of 489 million gallons. The new reservoir will contain 14 days' supply for the city, at the rate of 50 million gallons per day: and the Mugdock reservoir, nearly 10 days' supply—together 24 days' supply. The embankment is nearly a mile long, and is 93 feet high above the bed of a small stream which formerly flowed through the site. The reservoir forms part of the scheme for duplicating the water-works, so as to afford a supply of 100 million gallons per day to the city. The turning of the first sod was performed by the late Lord Provost M'Onie on Nov. 20, 1883, in presence of the Water Committee; and the works have been prosecuted since that day with only one interruption. The turnpike road to Strathblane, which formerly ran through the middle of the reservoir, had first to be diverted for a length of three-quarters of a mile; and then all the streams which ran through the site had to be collected and diverted, by agreement with the landed proprietors, by a 24-inch cast-iron pipe, about a mile long, carried into the Allander Water. These operations occupied about two years, and cost £15,000. The works upon the reservoir proper were begun in July, 1886; the contract having been let to Messrs. Robert Carlisle and Co., for £104,552. This firm only executed £22,000 worth of work, when, after eighteen months, they had to surrender their contract. The work was re-let to Messrs. Morrison and Mason in May, 1888, eight years ago; and this firm have carried it to completion. The distinguishing feature of the reservoir is its puddle trench. Although an extensive series of bores were put down on the site of the embankment, the nature of the foundation was not disclosed till the trench was actually sunk. Instead of a depth of 20 or 30 feet, which had been calculated upon, it varied from 35 feet at the western end to 193 feet at the northern end. Much water was encountered—from 400,000 to 450,000 gallons per day had to be raised a height of about 150 feet for three years; and from the exceptional nature of the work, it was withdrawn from the contract, and was executed at the cost and risk of the Water Commissioners. The quantity of rock excavated from the puddle trench was 168,000 cubic yards; and the total cost, including plant, pumping water, and all other charges, was £74,000. It is estimated that it will take nearly a year to fill the reservoir. After the ceremony of turning on the water, the company who had been invited to view it were entertained to luncheon.

The Edinburgh and District Water Trustees yesterday paid a visit of inspection to the new Taller water-works. Almost the only work which has yet been attempted is the construction of a railway from Broughton station to the site of the reservoir—8½ miles—and this is expected to be completed in the autumn. At the site of the reservoir, a trench is being dug along the whole length of the embankment, to enable intending offerers for the work of constructing the embankment to see the depth they will require to go, and the nature of the materail to be dealt with. Though this trench will cost more than £3000, it is expected that it will, by removing the element of uncertainty from the minds of contractors, lead to the saving of a much larger sum when the contract comes to be let.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 13.

Sulphate of Ammonia.—There has been no new feature in the market to comment upon; and the situation remains as last reported. Makers generally, being comfortable in regard to stocks, have been in a position to maintain a firm attitude; and the quotations remain £7 18s. 9d. f.o.b. Leith, and £8 to £8 2s. 6d. other ports. In the forward position, there is considerable inquiry; but buyers will not come up to the prices required by makers, who are not at all keen about selling ahead.

Nitrate of Soda is easier in all positions; deliveries during the past two months having been disappointing—the manure season being now practically over, and larger stocks than were anticipated having to be carried forward. There are now sellers on spot at 7s. 9d. for ordinary, and at 7s. 10½d. for refined quality.

LONDON, *June* 12.

Tar Products.—The business of the week has been marked by a rapid advance in the price of benzol; and buyers seem to have sufficient courage and faith in the future to be willing to pay the prices quoted below to the end of the year. This looks as if stocks in this country are unusually low, and emphasizes the fact that the tar production during the past season has been much below the normal quantity. Unfortunately for tar distillers, most of them will have been caught at much lower prices, as, having passed through a period of unparallelled depression in all the light tar products, during which 90's benzol was sold largely at 10d. per gallon, the slow advance in price which took place since then will have tempted makers to contract for some distance ahead, as the price improved. Pitch buyers hold aloof; and, so far, very little business for next season seems to have been fixed. Makers have no stocks, and are pretty easy about future business. One or two somewhat important sales, however, have been made at prices quoted below. A fair business is being done in tar oils. There is no fresh movement in anthracene; and values are quoted firm at Committee's prices. Carbolic is picking up a little; but so far the hot weather has not improved its value, as was expected.

The following prices have obtained during the week: Tar, 19s. to 25s., according to position and quality. Pitch, nominal, 32s. to 34s. Benzol, 90's, 2s. 9d.; 50's, 2s. 4d. Toluol, 2s. Solvent naphtha, 1s. 4d. Crude, 30 per cent., naphtha, 11½d. Creosote, 1½d. Salts, pressed, 55s.; drained, 35s. Cresylic acid, 1s. 1d. Carbolic, 60's, 2s. Anthracene, nominal, "A," 10½d.; "B," 8d. to 9d.

Sulphate of Ammonia shows a moderately steady market; but the long-hoped-for improvement in prices seems as far off as ever. Makers continue to sell from hand to mouth; and buyers are not eager for forward business, though in some cases an advance of 5s. to 10s. per ton can be got for forward contracts, depending on the extended period of them. £8 at all ports, less 3½ per cent., is to-day's value. Gas liquor is officially quoted at 6s. to 7s.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—Several of the most important of the gas-coal contracts, including those of Manchester and Salford, are now under consideration; tenders having been sent in during the past week In addition, there are also a number of smaller contracts which are in a similar position; but as yet no large quantities have been definitely settled for. A few small contracts have been placed, in odd cases, at something like last year's prices. Generally, however, there is a slight easing down upon the prices which were obtained twelve months ago. Taking 6s. 6d. as about the average basis upon which contracts were secured last season, for Wigan four-feet gas coals, the average figure on which tenders are being based this year is about 6s. 3d. per ton. Arley gas coals are, however, maintaining their prices rather better than the lower qualities; and it is very exceptional where under 7s. per ton is being quoted, in some instances slightly above this figure being asked. The gas companies and corporations, which have now largely adopted the plan of enriching their gas with oil rather than using the high-class gas coals previously used, are chiefly taking the lowest qualities of coal that can be employed for gas-making purposes; so that the giving way in prices will affect the bulk of the business which is likely to be put through. The conditions which are imposed in connection with the contracts of one of the large corporations, and which are also being followed by some of the smaller consumers, are strongly objected to by colliery owners in this district. These conditions practically stipulate that, in the event of a general strike or lock-out, the contract shall be fully supplied out of stocks, wherever they are held; and several of the principal Lancashire colliery concerns have declined altogether to tender on these conditions, which they contend would be absolutely unfair to their other customers who might have contracts, and for whom their stocks would be reserved equally with the gas companies. In the general coal trade, a quiet tone is reported as regards business in all descriptions, except engine fuel; and the dearth of orders is compelling colliery owners to put their pits on short time—four days per week being now the general average. House coals are only in the most limited request, with prices weak, though list rates are nominally unchanged. Steam and forge coals also show no improvement. Business in these continues extremely slow; and very low prices are quoted on sales of any magnitude. At the pit mouth, the average figures are about 9s. 6d. to 10s. per ton for best Wigan Arley; 8s. to 8s. 6d. for Pemberton four-feet and seconds Arley; 6s. 6d. to 7s. for common house coal; and 5s. 6d. to 6s. for good ordinary steam and forge coals. There is a good demand for engine fuel; and with supplies becoming less plentiful, prices tend to harden up. Slight advances are being talked of; but as yet no general upward move has taken place. The average selling prices remain at 4s. 6d. to 5s. per ton at the pit for better qualities, and 3s. to 3s. 6d. for common slack. The shipping trade shows no signs of reviving activity, and prices remain at recent

GAS AND WATER COMPANIES' STOCK AND SHARE LIST (see ante, p. 1336).

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	15 Apl.	10½	Alliance & Dublin 10 p. c.	25–26	..	4 0 9
100,000	10	,,	7½	Do. 7 p. c.	17–18	..	4 3 4
300,000	100	2 Jan.	5	Australian (Sydney) 5 % Deb.	110–112	..	4 9 3
200,000	10	12 June	5	Belgrano (B. Ayres), Limited	9–9½*	..	5 5 3
100,000	Stck.	30 Dec.	5	Do. 5 p. c. Deb. Stk	100–105	..	4 15 3
200,000	5	29 May	6½	Bombay, Limited	7¼–7¾	..	4 3 10
40,000	5	,,	6½	Do. New, £4 paid	5¾–6	..	4 6 8
380,000	Stck.	27 Feb.	12	Brentford Consolidated	288–293	+3	4 1 10
210,000	,,	,,	9	Do. New	220–225	+3	4 0 0
50,000	,,	,,	5	Do. 5 p. c. Pref.	—	..	—
159,375	,,	12 June	4	Do. 4 p. c. Deb. Stock.	130–134*	+2	2 10 9
220,000	Stck.	27 Mar.	11	Brighton & Hove Original	237–242	..	4 10 11
208,820	,,	,,	8	Do. A Ord. Stk.	190–195	..	4 2 0
933,500	Stck.	27 Feb.	5	Bristol, 5 p.c. max.	127–132	..	3 15 9
420,000	20	27 Mar.	11½	British	56–57	..	3 18 11
50,000	10	12 Mar.	11½	Bromley, Ordinary 10 p. c.	22⅓–23⅓	..	4 17 11
71,000	10	,,	8½	Do. 7 p. c.	19–20	..	4 5 0
500,000	10	29 Apl.	5	Buenos Ayres (New) Limited	9¼–9⅝	..	5 2 7
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	103–105	..	5 14 3
150,000	20	27 Feb.	8½	Cagliari, Limited	29–31	..	5 6 5
100,000	10	29 May	8	Cape Town & District, Ltd.	17–18	+⅛	4 8 11
50,000	50	2 May	6	Do. 6 p. c. 1st Mort.	58–60	..	5 0 0
550,000	Stck.	15 Apl.	13⅓	Commercial Old Stock	342–347	+2	3 17 8
165,000	,,	,,	10⅔	Do. New do.	258–263	..	2 19 10
165,000	,,	12 June	4½	Do. 4½ p. c. Deb. do.	145–150*	+½	3 0 0
800,000	Stck	12 June	13	Continental Union, Limited.	283–288*	+3	4 10 4
200,000	,,	,,	10	Do. 7 p. c. Pref.	217–222*	+2½	4 10 1
51,600	Stck.	27 Feb.	14	Croydon Com'cial A 10 p. c.	—	..	—
157,500	,,	,,	11	Do. B 7 p. c.	—	..	—
535,000	Stck.	27 Feb.	5½	Crystal Palace Ord. 5 p.c. Stk	130–135	..	3 17 9
60,000	,,	,,	5	Do. 5 p. c. Pref.	—	..	—
486,090	10	30 Jan.	11	European, Limited	26–27	..	4 1 6
354,060	10	,,	11	Do. £7 10s. paid	17½–18½	..	4 9 3
5,746,590	Stck.	13 Feb.	12¾	Gaslight & Coke, A, Ordinary	308–313	−2	4 1 5
100,000	,,	,,	4	Do. B, 4 p. c. max.	108–113	..	3 10 9
665,000	,,	,,	10	Do. C, D, & E, 10 p. c. Pf.	297–302	..	3 6 3
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	145–150	..	3 6 8
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	210–215	..	3 9 9
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	205–210	..	3 6 8
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	295–300	..	3 6 8
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	172–177	..	3 7 10
1,061,150	,,	12 June	4	Do. 4 p. c. Deb. Stk.	138–143*	..	2 15 11
294,850	,,	,,	4½	Do. 4½ p. c. do.	148–153*	+½	2 18 9
908,000	,,	,,	6	Do. 6 p. c. do.	203–207*	+1½	2 18 0
70,000	10	14 May	6	Hongkong & China, Limited	12½–13½	..	4 8 10
3,800,000	Stck.	14 May	12	Imperial Continental	248–252	..	4 15 3
376,400	100	1 Feb.	4	Do. 4 p. c. Debs. Red.	100–103	..	3 17 8
473,600	Stck.	13 Feb.	3½	Do. 3½ p. c. Deb. Stk	109–111	+1	3 3 1
£			p. c.	GAS COMPANIES.			£ s. d.
75,000	5	16 Dec.	6	Malta & Mediterranean, Ltd.	6½–7	..	4 5 8
560,000	100	1 Apl.	5	Met. of Melbourne, 5 p. c. Deb.	115–118	..	4 4 10
250,000	100	,,	4½	Do. 4½ p. c. Debs.	110–112	..	4 0 4
541,920	20	12 June	5	Monte Video, Limited	16½–17½*	..	5 14 3
150,000	5	29 May	8	Oriental, Limited	8½–8⅝	..	4 11 5
135,000	5	,,	8	Do. New, £4 10s. paid	7½–7¾	..	4 12 10
15,000	5	,,	8	Do. do. 1879, £1 paid	1–2	..	4 0 0
60,000	5	12 Mar.	7	Ottoman, Limited	5–5½	..	6 7 3
166,870	10	—	2	Para, Limited	1¼–1⅝	..	—
420,000	100	2 Nov.	6	People's Gas) 1st Mtg. Bds.	105–110	..	5 9 1
500,000	100	1 June	6	of Chicago) 2nd Do.	102–107	..	5 12 1
250,000	10	27 Mar.	8	San Paulo, Limited	13–14	..	5 14 3
500,000	Stck.	13 Feb.	15½	South Metropolitan, A Stock	405–415	..	3 14 8
1,350,000	,,	,,	12	Do. B do.	315–320	..	3 15 0
310,000	,,	,,	13	Do. C do.	337–342	+2	3 16 0
800,000	,,	16 Jan.	5	Do. 5 p. c. Deb. Stk.	175–178	..	2 16 2
60,000	Stck.	12 Mar.	11½	Tottenham & Edmonton, A	250–255	..	4 10 2
60,000	,,	,,	8½	Do. B	—	..	—
170,380	10	29 May	10	Tuscan, Limited	13½–14½	..	6 18 0
149,900	10	2 Jan.	5	Do. 5 p. c. Debs. Red.	100–102	..	4 18 0

WATER COMPANIES.

746,021	Stck.	30 Dec.	10½	Chelsea, Ordinary	347–352	..	2 18 3
150,000	,,	,,	5	Do. 5 p. c. Pref.	172–177	..	2 16 6
160,000	,,	,,	4½	Do. 4½ p. c. Pref. Stk., 1875	—	..	—
175,785	,,	27 Mar.	4½	Do. 4½ p. c. Deb. Stock	158–163	..	2 15 2
1,719,514	Stck.	15 Apl.	7	East London, Ordinary	245–250	..	2 16 0
654,740	,,	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	157–162	..	2 15 6
100,000	,,	,,	3	Do. 3 p. c. Deb. Stk.	105–107	..	2 16 1
700,000	50	12 June	7½	Grand Junction, 10 p.c. max.	125–130*	+1¾	2 17 8
280,000	Stck.	27 Mar.	4	Do. 4 p. c. Deb. Stk.	149–153	+1	2 12 4
708,000	Stck.	13 Feb.	12	Kent	347–352	..	3 8 3
160,000	,,	,,	7	Do. New, 7 p. c. max.	215–220	..	3 3 7
1,043,800	100	30 Dec.	7½†	Lambeth, 10 p. c. max.	275–280	..	2 11 8
406,200	100	,,	7½†	Do. 7½ p. c. max.	227–232	..	3 2 6
350,000	Stck.	27 Mar.	4	Do. 4 p. c. Deb. Stk.	147–152	..	2 12 8
500,000	100	13 Feb.	12¾	New River, New Shares	435–440	+2	2 18 0
1,000,000	Stck.	30 Jan.	4	Do. 4 p. c. Deb. Stk.	154–159	..	2 10 4
1,902,300	Stck.	12 June	4	S'thwk & V'xhall, Ordinary	165–170*	..	2 7 1
126,500	100	,,	4	Do. Do. 7½ p. c. Max.	153–163*	..	2 9 1
489,200	Stck.	,,	5	Do. Do. 5 p. c. Pref.	165–170*	−½	2 18 10
1,019,585	,,	15 Apl.	4	Do. 4 p. c. A Deb. Stk.	147–152	..	2 12 8
1,155,066	Stck.	12 June	10	West Middlesex	322–327*	..	3 1 2
200,000	,,	,,	4½	Do. 4½ p. c. Deb. Stk.	155–160*	+½	2 16 3

† Next dividend will be at this rate. *Ex div.

unremunerative rates; 7s. being the full average figure for ordinary steam coal delivered at Mersey ports.

Northern Coal Trade.—There has been continued activity in the steam-coal branch of the Northern coal trade during the last week or so; and a slightly better demand is at last beginning to show itself for gas coal, as the low freights are tempting users to commence to stock early, while the uncertainty of labour prospects in the Midlands tends in the same direction. Best Northumbrian steam coals are firm at 8s. 3d. per ton f.o.b.; steam smalls being perhaps a trifle easier at 3s. 9d. per ton—the production in the latter case having been, of course, increased with that of the best coal. The collieries are now working well, and are likely to do so for some time to come, as the demands of the Northern ports seem large this year. There is little alteration in the price of manufacturing coal, or in the position of that branch of the trade; most of the deliveries being on contracts at old prices. Gas coals are, perhaps, in a slightly better demand. Some of the collieries that ship this class are now well employed, though the home consumption is only very limited. The price of best Durham gas coal varies from 6s. 3d. to 6s. 9d. per ton f.o.b.; and any contracts that are now being taken are at something like these prices. There is a good demand for coke for use at the blast furnaces in the Durham and Teesside district, and also at those in West Cumberland and Barrow. For this coke, the basis-price is about 13s. 9d. per ton at the Teesside furnaces; and the production is well taken up. The coke export is rather weak; and about 14s. 9d. per ton f.o.b. is the quotation for coke for shipment. There is no change in the gas coke trade. The demand is only very languid; and the price is rather weak—the exports having been low of late.

Scotch Coal Trade.—There has set in a slight slackening of the demand for all sorts except the best ell, which is still in good request. For all other kinds, the trade is slower; and it is almost entirely of the same from day to day character. The prices remain unaltered, and are quoted at: Main, 5s. 9d. (easy) per ton f.o.b. Glasgow; ell, 6s. 3d. to 6s. 9d.; splint, 6s. 3d. to 6s. 6d.; and steam, 7s. 6d. The shipments during the week amounted to 143,387 tons—a decrease of 9392 tons, when compared with the preceding week, and of 4902 tons on the corresponding period of last year. For the year to date, the total shipments have amounted to 2,990,246 tons—an increase upon the quantity in the same period of last year of 190,868 tons.

New Reservoirs at Hampton.—A large number of members of the Incorporated Association of Municipal and County Engineers recently visited the new water-works which Messrs. John Aird and Sons are constructing at Hampton for the Southwark and Vauxhall Water Company. The completed reservoir, which will hold 96 million gallons of water, is 13 acres in area and 40 feet deep. A second reservoir, which is in course of construction, will hold 200 million, and a third, 100 million gallons; and they will occupy some 39 acres of land. No water has up to the present been pumped into the finished reservoir; but arrangements are being made to utilize it shortly.

New Water-Works for Carlisle.—Since the rejection of the scheme for obtaining for the city of Carlisle a supply of water from Mosedale and the higher reaches of the Caldew, the Gas and Water Committee of the Corporation have been from time to time considering the water question in its various aspects, with a view to devising some plan which would be more economical in general cost, and would be free from the alarming contingencies which proved fatal to their previous proposals. Continued and increasing complaints from the higher parts of the city have furnished them with further convincing evidence of the necessity of taking action in the matter without delay; and, under their instructions, Mr. C. B. Newton, the Gas and Water Engineer, has devoted close attention to the subject. He has surveyed various watersheds in the districts—some of them being sources of supply which have not hitherto been brought within the range of inquiry; and there is reason to hope that his labours will have results that will prove satisfactory to the Council and all concerned. Mr. Newton brought before the Committee a few days since some of the results of his investigations; and the Committee were gratified to find that he had discovered a source within easy distance from which it is thought possible an ample supply of water of first-class quality may be obtained. Some further inquiries have, however, to be made before any definite conclusion can be arrived at.

The Water Supply of Richmond.—The Richmond Town Council lately held a special sitting to consider an important report prepared by the Chairman of the Water Committee (Mr. T. H. Watney) and adopted by that body. It will be remembered that experiments have been made at the Terrace Gardens well at the expense of Mr. Watney, and under the direction of the Corporation Water Engineer (Mr. W. G. Peirce). The results, however, have not been so satisfactory as might have been hoped; but the work carried out has by no means been wasted. The total amount of public money spent on this well, adits, and plant has been £15,857; and it is shown that the water obtained—325,970,579 gallons—has well repaid the ratepayers the outlay when compared with what they had been paying for that quantity of water to the Southwark and Vauxhall Company. The advice of the Engineer is that a new adit at the same level as the existing one should be driven in a north-west direction, with branches in various ways from the main line; and it is suggested that the Council should make application to the Local Government Board for sanction to raise £5000 for the work. Several improvements and the provision of new machinery at the Water Lane works is proposed; the total expenditure upon which is £2195. The report includes suggestions as to the laying of new road water-mains at a cost of £2200, and the extension of river water mains to Kew, Petersham, and North Sheen. These various amounts total to £10,600. Some statistics were appended to the report, which showed that the total expenditure of the Council on the water undertaking had amounted to £94,497. Of this they had paid off upwards of £46,000; leaving the total indebtedness at £48,000. The matter was discussed by the Council at considerable length; and a resolution was passed agreeing to apply to the Local Government Board for the sum of £10,600.

Exhibitions of Gas Appliances.—Last Tuesday an exhibition which attracted a large number of visitors was closed at Brighouse. It had been arranged by the Gas Committee of the Corporation. The principal firms showing goods in the "gas line" were Messrs. C. Wilson and Sons, Messrs. George Bray and Co., and Messrs. Stott and Co. Miss Grace Holroyd's services were secured for the cookery demonstrations. During last week an exhibition of Messrs. Richmond and Co's. stoves, &c., was held at Bradford, under the auspices of the Gas Committee. Mrs. J. J. Middleton gave cookery lectures.

Sales of Shares.—Last Tuesday, 13 original £10 shares in the Eastbourne Gas Company realized by auction an average price of £33 7s. each; and some £10 "B" shares averaged £26 4s. each.——Some £5 shares in the Chatham, &c., Water Company recently fetched £15 8s. 6d. and £15 9s. 6d. per share.——Five fully-paid £5 shares in the Ash-next-Sandwich Gas Company were bought for £26 5s. each; and four £20 "B" shares (fully-paid) in the Colchester Gas Company made an average of £32 15s. per share.——There was lately a keen competition for 110 new £10 shares in the Marlow Gas Company; the average price paid being £11 12s. 6d. per share.——At Bury, on the 10th inst., Mr. J. R. Parkinson offered for sale a number of shares in gas companies, with the following results: £10 new ordinary shares (fully-paid) in the Radcliffe and Pilkington Gas Company, sold at £14 7s. 6d. and £14 10s. each; £5 "C" shares in the Hartlepool Gas and Water Company, at £9 17s. each; a £10 share in the same concern realized £19 6s.; and £110 of "A" stock of The Gaslight and Coke Company, sold at the rate of £311 2s. 6d. per cent.

The Profit of the St. Mary Church Gas Undertaking.—Some discussion has recently taken place as to the actual profit realized by the St. Mary Church District Council from the gas-works; and a local paper has published the figures. The entire revenue last year, including £264 in the Treasurer's hands, amounted to £3555—£2697 from the sale of gas, and £591 from coke, tar, &c.; while the expenses totalled £2240, thus leaving a balance of £1311. Deducting the £264 in the Treasurer's hands, there remained a profit of £1047. Of this amount, £890 went to the liquidation of the debt; leaving a net profit of £421. It is said by friends of the present administration that the undertaking has for several years past yielded a profit of £1000, which is equivalent to a rate of between 5d. and 6d. in the pound; and that though practically the whole of it has been absorbed by the fund for the redemption of the debt, the liability is being rapidly reduced, and that after the present year a goodly revenue will be left to be devoted to the relief of the rates. On the other hand, it is urged that a portion of the profit is derived by the imposition of an exorbitant charge for public lighting. It is admitted that about £90 is derived from an extra 1s. 9d. per 1000 cubic feet which the general district pays for gas for the public lighting; but this additional charge is defended on the ground that it compels those who are not private consumers of gas to pay their quota towards the reduction of the debt.

GWYNNE & BEALE'S
PATENT GAS EXHAUSTERS AND ENGINES.

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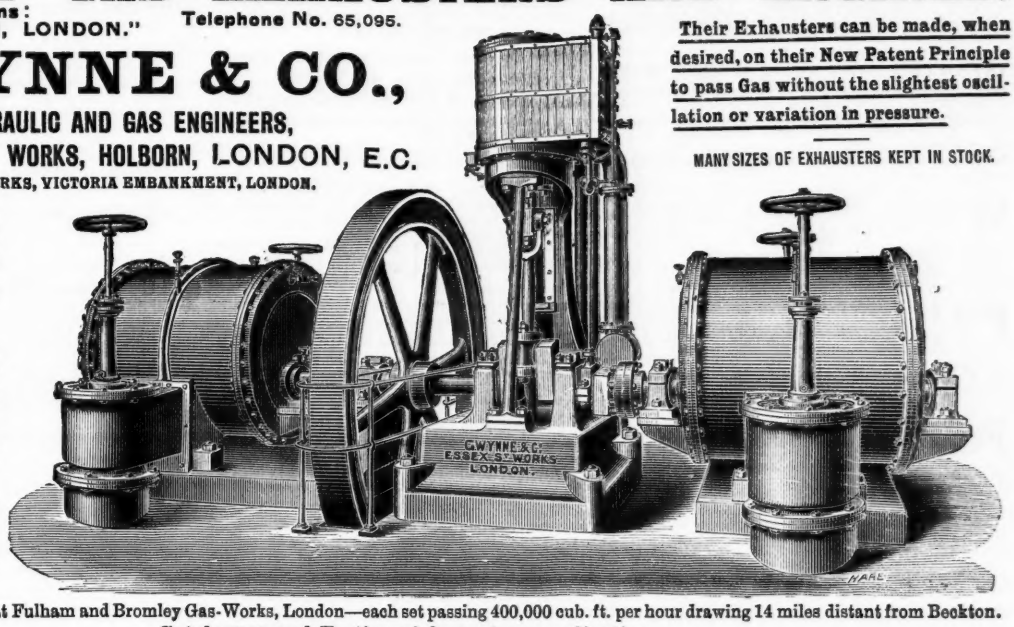
They have completed Exhausters to the extent of 32,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, PATENT RETORT-LIDS, STEAM-PUMPS for Tar, Liquor, or Water; CENTRIFUGAL PUMPS and PUMPING ENGINES, specially adapted for Water-Works, raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.



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MANY SIZES OF EXHAUSTERS KEPT IN STOCK.

Exhausting Machinery at Fulham and Bromley Gas-Works, London—each set passing 400,000 cub. ft. per hour drawing 14 miles distant from Beckton.

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WINKELMANN'S "VOLCANIC" CEMENT. Fire Resistance up to 4500° Fahr. In use in most Continental Gas-Works, and in more than 800 British Gas-Works.

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J. & J. BRADDOCK, Globe Meter Works, Oldham.

First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.

Telegraphic Address: "Braddock Oldham."

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JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from SULPHUR, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for, Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and adroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.

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SADLER & Co., Ld., Middlesbrough; ULVERSTON (BARROW); PORTSMOUTH; CARLTON (N.E.R.); and STOCKTON. Tar and Petroleum Distillers. Benzol and Petroleum Spirit, 700 and other Gravities, specially prepared for Carburetting. SOLAR OIL for Gas Making Kerosene, &c.

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JOHN E. WILLIAMS AND CO., VICTORIA PAINT WORKS, MANCHESTER.

For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

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OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality. Sample and Price on application.

OXIDE PAINTS, OILS, SULPHURIC ACID, &c. 120 and 121, NEWGATE STREET, LONDON, E.C.

Telegrams: "BOGORE, LONDON."

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FINEST Quality of Natural Bog Ore. Particulars and price, apply to Mr. T. L. ARCHER, 20, Fennel Street, MANCHESTER.

SULPHATE OF AMMONIA SATURATORS.

JOSEPH TAYLOR & CO., Chemical Plumbers, &c., and Makers of every description of Solid Plate Lead and Timber Cased Saturators, &c. CENTRAL PLUMBING WORKS, TOWN HALL SQUARE, BOLTON. Special Attention to Repairs.

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Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, NEWTON GRANGE, NEWBATTLE, DALKEITH, } SCOTLAND.

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NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS, should be received not later than the FIRST POST on SATURDAY.

GOLD MEDAL, 1892.

TUBES and Fittings for Gas, Steam, and Water, in stock to 8 inches diameter; Iron and Steel Ascension-Pipes.
JOHN SPENCER, Globe Tube Works, WEDNESBURY; and 14, Great St. Thomas Apostle, LONDON.

HUTCHINSON BROTHERS, Gas Engineers, &c., Falcon Works, Barnsley, Makers of Wet and Dry Gas-Meters, Brass-Work, and general Gas Apparatus, Lead Saturators, Tanks, &c., Tools, and Gas-Works Sundries. (See p. 1250., last week's issue.)
Telegrams: "HUTCHINSON BROS., BARNSLEY."

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THE RELIANCE LUBRICATING OIL COMPANY SUPPLY on APPROVAL "RELIANCE" NON-CORROSIVE LUBRICANTS (which, through their superiority, have the largest sale in the world)—viz., Engine, Cylinder, and Machinery Oils, 11½d.; Spindle Oil, 8½d.; Gas-Engine and Dynamo Oils, 1s. 6d. per gallon; Barrels Free and Carriage Paid. Also Liquids for Gas Making, Enriching, &c.
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WANTED, by a young married Man (Total Abstainer), a Situation as MANAGER of Gas-Works. Eight years' Manager in Canada. Used to Engine, &c. Can lay Mains, Services, fix Meters, and do all Mechanical Alterations and Repairs in or out of Works.
Address SQUIRE, care of A. Thomas, Gas-Works, COWES.

WANTED, a steady and trustworthy GAS STOKER, used to Engine and Exhauster and Shovel Charging. Permanent employment to a reliable Man. House, Coal, and Gas free.
Apply, stating Age and Wages required, to Mr. G. MOAT, Manager, Gas-Works, Purston, PONTEFRACT.

FOR IMMEDIATE SALE—A 60-foot diameter TELESCOPIC GASHOLDER, with eight Cast-Iron Columns, in good working order.
To treat for, and view the same, apply to W. C. HOLMES AND CO., Gas Engineers and Contractors, HUDDERSFIELD.

FOR SALE—One single-lift Gasholder, 50 feet diameter 20 feet deep, with Cast-Iron Tank, 51 ft. 6 in. inside diameter 20 feet deep, six Guide Columns and Wrought-Iron Top Bracing, 8-inch Inlet-Pipe and Valve, and 12-inch Outlet-Pipe and Valve, complete with Syphons.
The Cast-Iron Tank is strongly stayed, with Wrought-Iron encircling Straps on the outside; and, if not used for its present purpose, it would make a suitable Storage Tank for a small Water-Works.
Two vertical MULTITUBULAR GAS-HEATED STEAM-BOILERS, 3 feet diameter, 18 feet high, with 25 3-inch Steel Tubes, suitable for a working pressure of 80 lbs., complete with Steam and Water Fittings.
One GAS WASHER, 4 feet by 4 feet by 12 feet high.
One Samuelson and Co.'s "O" Size "ACME" EXHAUSTER and 14 in. by 14 in. DUPLEX ENGINE combined, having a capacity of about 10,000 cubic feet per minute.
The above Plant has only worked a short time, and is almost new. No reasonable offer for the whole or any part of it will be refused, as it has to be cleared away at once to make room for further extensions.
Apply to THOS. FIRTH AND SONS, LIMITED, Norfolk Works, SHEFFIELD.

FOR SALE—One Rotary Engine and EXHAUSTER, to pass 35,000 cubic feet of Gas per Hour, with Governor, &c., complete. One DEMPSTER'S HORIZONTAL ENGINE and EXHAUSTER, with double Cylinder, to pass 35,000 cubic feet of Gas per Hour, with Governor Connections. Also about 360 feet of 18 in. by 18 in. HYDRAULIC MAIN, with 5-inch Stand-Pipes, Bridge-Pipes, Mouthpieces, &c.
The above are all in good condition, are suitable for smaller Gas-Works, and are being replaced by Apparatus of larger size.
The apparatus may be seen, or any further Information obtained, on application to Mr. William Smith, Gas Engineer, Lum Street Gas-Works, Bolton.
Gas Offices, Bolton,
June 2, 1896.

TIPTON GAS-WORKS.

COAL CONTRACTS.

THE Gas Committee of the Tipton Urban District Council are prepared to receive TENDERS for the supply of GAS COAL, for a period of One, Two, or Three Years, from the 1st of July next, to be delivered, carriage free, to the Gas-Works Siding (L. & N. W. Railway).
Specifications and Form of Tender may be obtained at the Gas-Works, on application to Mr. Vincent Hughes, the Engineer and Manager.
Sealed and endorsed tenders to be sent to me the undersigned not later than Ten a.m. on Saturday, the 27th inst.
The Committee do not bind themselves to accept the lowest or any tender.

By order,
GEO. M. WARING,
Clerk to the Council.

Public Offices, Tipton,
June 8, 1896.

SULPHATE OF AMMONIA SATURATORS.

WALTER THOMASON and SONS, Chemical Plumbers, &c., and Makers of Lead Saturators, &c., 21, WESTON STREET, BOLTON. Repairs of every description.
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To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
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MALMO, SWEDEN.

INTERNATIONAL COMPETITION FOR PROPOSALS FOR NEW GAS-WORKS.

THE Board of the Malmo Corporation Gas-Works invite PROPOSALS for the erection of new GAS-WORKS in Malmo.
Plans, and Programme, in the Swedish, English, or German Language, may be obtained on application to the Gas-Works Office.
Three Prizes—viz., 3000, 2000, and 1500 Swedish Crowns—will be given to the successful Competitors.
Proposals to be delivered not later than the 1st day of November, 1896.
For each Programme a fee of Three Swedish Crowns is charged, which must accompany the application.
THE BOARD OF THE GAS-WORKS.
Malmo, May, 1896.

TENDERS FOR GAS COAL.

TENDERS are invited by the Yorktown and Blackwater Gas and Coke Company, Limited, for the supply of 800 Tons (more or less) of really good GAS COAL, to be delivered in Trucks at the Blackwater Station (S.E. Railway), Carriage Paid, in quantities of about 60 or 80 Tons, as ordered by the Secretary, giving a week's notice before expected at the Station.
Sealed tenders forwarded to the Secretary will be laid before the Directors the latter part of this month.
The Directors do not bind themselves to accept the lowest or any tender.
June 10, 1896.

GAS COAL.

THE Bethesda Urban District Council are prepared to receive TENDERS for the GAS COAL required at their Gas-Works during the ensuing Year in such quantities and at such times as may be required (in all about 300 Tons) from the 1st of August, 1896, to the 31st of July, 1897.
The person whose tender is accepted will be required to enter into an Agreement with the Council for the due performance of his contract.
The lowest or any tender not necessarily accepted.
Tenders to be sent to me on or before the 29th inst.
R. BENJAMIN EVANS,
Clerk.
Bron Arfon, Llanllechid, near Bangor,
June 12, 1896.

BOROUGH OF NOTTINGHAM.

(WATER DEPARTMENT.)

TENDERS FOR THE SUPPLY OF VALVES AND HYDRANTS, PIPES, LEAD, COAL, TAPS, AND FITTINGS.

THE Water Committee of the Corporation are prepared to receive TENDERS from competent Ironfounders, Brassfounders, Valve Manufacturers, Lead Merchants, and Colliery Proprietors, and Coal Merchants, for the supply of the undermentioned goods for the ensuing Year:—

1. CAST-IRON DOUBLE-FACED SLUICE VALVES and HYDRANTS.
2. CAST-IRON MAIN PIPES.
   CAST-IRON SPECIAL PIPES.
3. LEAD PIPING.
   LEAD INGOTS.
4. GUN METAL TAPS and FERRULE FITTINGS.
5. STEAM COAL and OTHER FUEL.

Specifications and Drawings, together with Samples, Weights, &c., may be seen, and other Information obtained, at the Office of the Water Engineer, Mr. D. M. F. Gaskin, St. Peter's Church Side; and Forms of Tender may be obtained at that Office on payment of One Guinea, which sum will be returned on receipt of a *bonâ-fide* tender.
Tenders, endorsed "Tender for Valves," "Tender for Pipes," "Tender for Lead," "Tender for Taps," or "Tender for Coal," to be delivered to me at the Guildhall, Nottingham, on or before the 29th day of June inst.
The Committee do not bind themselves to accept the lowest or any tender.

By order of the Water Committee,
SAMUEL G. JOHNSON,
Town Clerk.

Guildhall, Nottingham,
June 11, 1896.

ECONOMY IN PURIFICATION.

INCREASE the Efficiency of your PURIFIERS by adopting CRIPPS'S PATENT BYE-PASS VALVE in the lower Tiers of Sieves. Practical Experience proves their Economy. Engineers are repeating orders after thorough trial.
References and Particulars can be obtained from the Makers—
C. & W. WALKER, Midland Iron-Works, Donnington, near Newport, SALOP.
And J. EVERY & SON, Phœnix Iron-Works, LEWES.

LUDLOW UNION GAS COMPANY.

THE Company are prepared to receive TENDERS for the supply during the Twelve Months from June 30, 1896, to June 30, 1897, of from 1200 to 1500 Tons of best screened GAS COAL, in quantities and at times to suit the requirements of the Company.
Tenders to be forwarded to J. W. MONTFORD, Solicitor, Ludlow, SALOP.

URBAN DISTRICT COUNCIL OF STOURBRIDGE.

(GAS DEPARTMENT.)

THE Gas Committee of the above Council are prepared to receive TENDERS for the purchase of their surplus TAR for a period of Twelve Months, commencing July 1, 1896.
Particulars and Forms of Tender may be obtained on application to the undersigned.
Tenders to be sent in before Wednesday, July 8, 1896, to be endorsed "Tender for Tar," and addressed to the Chairman of the Gas Committee, care of
WM. NORTH,
Engineer and Manager.
Gas-Works, Stourbridge,
June 10, 1896.

BRIERLEY HILL DISTRICT GASLIGHT COMPANY.

TENDERS FOR COAL.

THE Directors are prepared to receive TENDERS for the supply of 5000 Tons of GAS COAL, delivered to Brettell Lane or Round Oak Siding (G.W.R.), in such quantities as may be required from the 1st of July next to the 30th of June, 1897.
Tenders, stating price per ton (20 cwt.), delivered to the above-mentioned Stations, with latest Analytical Test, to be sent, addressed to the Chairman of the Company, and marked "Tender for Coal," not later than the 26th inst.
The Directors reserve the right to accept tenders for the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.
No Tender Forms issued.

By order,
HENRY M. JACKSON,
Secretary.

Board-Room, Gas-Works, Brierley Hill,
June 10, 1896.

BOROUGH OF MACCLESFIELD.

THE Gas Committee are prepared to receive TENDERS for the supply of the undermentioned MATERIALS required during a period of Twelve Months, commencing the 1st of July, 1896, viz.,—

1. The Best Hand-picked BUXTON LIME, delivered fresh at Macclesfield, free from Dirt and Ashes, in such quantities as may be ordered.
2. Wrought-Iron Lap-welded STEAM TUBES and FITTINGS.
3. Cast-Iron MAINS and IRREGULARS.
4. OILS, PAINTS, and DRUGGISTS' SUNDRIES.

Forms of Tender, &c., may be obtained on application to the Manager, Gas-Works.
Sealed tenders, properly endorsed, to be addressed to the Chairman, Gas Committee, Town Hall, Macclesfield, and to be sent in not later than Wednesday, the 24th of June, 1896.
The Committee do not bind themselves to accept the lowest or any tender.

W. FREDK. TAYLOR,
Town Clerk.

June 8, 1896.

COUNTY BOROUGH OF BRADFORD.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas and Electricity Supply Com- mittee of the Bradford Corporation are prepared to receive TENDERS for the supply of best GAS COAL, COBBLES, NUTS, and CANNEL, all to be well-screened, dressed, and free from Shale and Pyrites, to be delivered at the several Works of the Corporation in the Borough during the period of One Year or of Two Years, commencing on the 1st day of August next, as may be agreed upon.
Form of Tender, with any further Information required, may be had on application to Mr. Wood, Gas Engineer, Town Hall.
Sealed tenders, endorsed "Tender for Coal," to be sent to me on or before Wednesday, the 1st of July next.
An assurance must be given by each contractor that he pays to the workmen employed by him not less than the minimum Standard Rate of Wages.
The Committee do not bind themselves to accept the lowest or any tender.

By order,
W. T. M'GOWEN,
Town Clerk.

Town Hall, Bradford,
June 5, 1896.

THE Derby Gaslight and Coke Company are prepared to receive OFFERS for 20 to 50 Tons of SULPHATE OF AMMONIA.

Terms and Conditions, with Sample, to be obtained from Mr. C. Taylor, Gas-Works, Cavendish Street, Derby.

Tenders must be delivered, endorsed "Tenders for Sulphate of Ammonia," on or before Thursday, the 25th inst.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TENDERS FOR COAL AND CANNEL.

THE Directors of the Radcliffe and Pilkington Gas Company invite TENDERS for about 10,000 Tons of GAS COAL and CANNEL.

Particulars may be obtained from the undersigned, to whom tenders, properly endorsed, must be delivered on or before Friday, the 26th inst.

JAMES BRADDOCK,
Manager and Secretary.

Gas Offices, Radcliffe,
June 10, 1896.

THE Corporation of Middleton are pre- pared to receive TENDERS for the purchase of the TAR made at their Gas-Works, for One, Two, or Three Years, commencing on the 1st of August next.

Fuel carbonized per annum, about 9000 Tons.

Further Particulars and Form of Tender may be had from Mr. Duxbury, Gas Manager.

Tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Tar," to be delivered at my Office on or before the 17th of June, 1896.

FREDERICK ENTWISTLE,
Town Clerk.

Town Clerk's Office, Middleton,
June 8, 1896.

BIRSTALL URBAN DISTRICT COUNCIL GAS-WORKS.

THE Urban District Council invite TENDERS for the supply of 2000 Tons of good GAS COAL, well screened, and free from Pyrites, for One Year, to be delivered at the L. & N. W. Railway Station, Birstall, or at the Gas-Works, not later than the 30th of June, 1897, in such quantities, and at such times, as may be required by the Council.

Tenders, sealed and endorsed, to be sent to me not later than noon on Monday, the 22nd of June, 1896.

The Council do not bind themselves to accept the lowest or any tender, nor are forms of tender supplied by the Council.

WM. MIDDLEBROOK,
Solicitor, Clerk to the Council.

Council Offices: Birstall, near Leeds,
June 10, 1896.

BOROUGH OF WARRINGTON.
(GAS DEPARTMENT.)

COAL AND CANNEL.

THE Gas Committee invite Tenders for the supply of 12,000 Tons of COAL and 3000 Tons of CANNEL.

Full Particulars can be obtained on application to Mr. W. S. Haddock, Engineer to the Works.

Sealed tenders, endorsed "Tenders for Coal or Cannel," as the case may be, and addressed to the Chairman, Gas Committee, to be sent in not later than the 25th inst.

FREDK. TAYLOR,
Secretary.

Gas Offices, Warrington,
June 5, 1896.

HARROGATE GAS COMPANY.

SALE OF NEW ORDINARY SHARES OF £10 EACH BY TENDER.

THE Directors of the Harrogate Gas Company are prepared to receive, not later than Twelve o'clock noon, on Wednesday, the 1st day of July, 1896, TENDERS for any number, not exceeding 286 or less than 5, of NEW ORDINARY SHARES of £10 each, which, when paid up, will be consolidated with existing "C" Stock.

Forms and Conditions of Tender may be obtained at the Gas Office, Harrogate, or will be sent by post on application.

By order,
H. WILKINSON,
Secretary and General Manager.

Gas Offices, James Street, Harrogate,
June 9, 1896.

THE Sunderland and South Shields Water Company invite OFFERS of THREE NEW STEEL BOILERS, of about 30 feet by 7 feet, with all the Fittings complete, delivered and fixed, capable of working up to 80 lbs. Pressure. Also a pair of PUMPING-ENGINES, capable of lifting 3 million Gallons of Water in 24 hours from a depth of say 85 fathoms. The Engines to have Surface Condensers (the Water pumped to be used for condensing), with Expansion Valve Gear for working the Engines, either as condensing or non-condensing, with two sets of Well Pumps suitable for sinking purposes, with Connecting-Rods, Spear Plates, Buckets, Clacks, Bucket and Clack Doors, and Cisterns complete. The Engines to have Pumps or Rams attached to force the Water to an additional height of 17 fathoms when required.

The whole of the above (with the exception of the Pumps) to be delivered and fixed complete on the Company's new Works at Thorpe, near Easington, and kept in repair for twelve months after commencing to work. The Pumps to be delivered on the Company's Land, and to be fixed by the Water Company's Workmen under the superintendence of the Contractor.

Early delivery can be taken.

The Company will not be bound to accept the lowest or any offer.

For further Particulars, apply at the Company's Offices, 16, Fawcett Street, Sunderland.

Offers on or before the 23rd inst.

June 2, 1896.

SURPLUS TAR.

THE Gas Committee of the Corporation of Coventry are prepared to receive TENDERS for the purchase of the surplus TAR produced at their Works, Coventry, for One Year from July 1 next.

Make about 2000 Tons per annum.

Tenders, stating price per ton delivered into Boat, to be sent to the Manager by June 22, and marked "Tender for Tar."

The Committee do not bind themselves to accept the highest or any tender.

GEO. WINSTANLEY, Assoc.M.Inst.C.E.,
Manager.

Gas-Works, Coventry,
June 15, 1896.

HORNSEY GAS COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS, so far as they relate to DEBENTURE STOCK only, WILL BE CLOSED on the 23rd inst., and RE-OPENED on the 2nd of July, 1896.

S. J. WILLIAMS,
Secretary.

Chief Office: 63, Chancery Lane, W.C.,
June 15, 1896.

WANDSWORTH AND PUTNEY GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of the Company, so far as the DEBENTURE STOCK only is concerned, WILL BE CLOSED on and from the 26th of June, until the 4th of July, both days inclusive.

By order,
CHAS. W. BRAINE,
Secretary.

Offices: North Street, Wandsworth, S.W.,
June 13, 1896.

TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company so far as they relate to the DEBENTURE STOCK WILL BE CLOSED at Ten o'clock forenoon on Friday, the 12th inst., and RE-OPENED on Friday, the 26th inst.

The Interest for the Half Year to the 30th of June, 1896, will be payable on the 1st day of July next to the Proprietors registered on the closing of the Books.

By order of the Board,
JAMES RANDALL,
Secretary.

Gas Offices: Willoughby Lane,
Tottenham, June 5, 1896.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing by Auction of GAS AND WATER SHARES under Parliamentary Powers.

He also holds MONTHLY SALES of GAS AND WATER SHARES at the Auction Mart, Tokenhouse Yard, E.C.

Terms for the issuing of Capital, and also for offering to auction Gas and Water Shares, and all Particulars relating thereto, may be had of Mr. Alfred Richards.

Offices: 18, FINSBURY CIRCUS, E.C.

BY ORDER OF THE DIRECTORS OF THE WEST HAM GAS COMPANY.

SALE OF £10,000 DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell by AUCTION at the Mart, London, E.C., on Wednesday, the 17th of June, at Two o'clock precisely, in Lots, £10,000 PERPETUAL 4 PER CENT. DEBENTURE STOCK OF THE WEST HAM GAS COMPANY, to be created under the Provisions of the West Ham Gas Act, 1889, and offering to Trustees and others an Investment of the soundest character.

Particulars of the SECRETARY of the Company, at the Offices, STRATFORD; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

BY ORDER OF THE DIRECTORS OF THE SOUTHEND GAS COMPANY.

SALE OF 400 SHARES.

MR. ALFRED RICHARDS will Sell by AUCTION, at the Mart, London, E.C., on Monday, July 6, at Two o'clock, in lots varying from Five to Ten Shares in each lot, 400 £10 SHARES (fully paid) in the SOUTHEND GAS COMPANY, ranking for a Standard Dividend of 7 per cent.; the last Dividend on the same class of Shares having been at this rate.

Particulars of the SECRETARY, at the Offices, SOUTHEND; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By Order of the Directors of the Aldershot Gas and Water Company, the Directors of the Colonial Gas Association, Limited, and other Owners.

GAS and WATER STOCKS, SHARES, and DEBENTURES IN THE FOLLOWING COMPANIES:—

Aldershot Gas and Water Company,
Commercial Gas Company,
Colonial Gas Association, Limited,
Lambeth Water-Works Company,
Wandsworth and Putney Gaslight and Coke Company,
Kingston-on-Thames Gas Company,
Belgrano (Buenos Ayres) Gas Company,
Lowestoft Water, Gas, and Market Company,
Hornsey Gas Company,
Great Yarmouth Water-Works Company,
Dorking Gas Company,

To be SOLD by AUCTION, by

MR. ALFRED RICHARDS, at the Mart, Tokenhouse Yard, E.C., on Monday, June 29, at Two o'clock precisely, in Lots.

Particulars may be obtained at the Mart; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

Price 6s., Cloth Bound,

THE CHEMISTRY OF ILLUMINATING GAS.

By N. H. HUMPHRYS, Assoc. M.Inst.C.E., F.C.S.

This work contains chapters on: The Relative Cost of Light from Gas, Oil, and Candles; Products of Combustion; The Sulphur Question; The Composition of Illuminating Gas; Water Gas; Various Gas-Making Processes; Oil Gas; Properties of Fluid Hydrocarbons; Tar for Gas-Making; Destructive Distillation; Condensation; and Purification.

WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL Co., Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by

Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton . .	10,500 Cub. Ft.
Illuminating Power . .	16·9 Candles.
Coke (of good quality) . .	67·5 per Cent.
Sulphur	0·58 ,,
Ash	2·73 ,,

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.

QUAYSIDE, NEWCASTLE-ON-TYNE.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.

Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Danish Gas Company, Bombay Gas Company, San Paulo Gas Company, Alliance and Dublin Consumers' Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For Prices, &c., apply to the

HARTON COAL COMPANY,

LIMITED,

Newcastle-on-Tyne.

W. H. PARKINSON,
FITTER.

All Sizes of Elevators and Conveyors of every class, for Coal, Coke, Mechanical Stoking, and all other purposes, made and erected by the NEW CONVEYOR COMPANY, LTD., Transport Appliance Works, SMETHWICK.

(ALL NEW PATTERNS)

BIRMINGHAM.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,

LIMITED,

NEWBATTLE COLLIERIES,

DALKEITH, N.B.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation.

Yield of Gas Per Ton. . 11,205 Cubic Feet.
Illuminating Power, $16\frac{7}{10}$ Stand. Sperm. Candl.
Coke (of good & pure quality) $13\frac{3}{4}$ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton. . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . $13\frac{1}{2}$ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar. . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor $94\frac{1}{2}$ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,

HOLMSIDE AND SOUTH MOOR OFFICES,

NEWCASTLE-UPON-TYNE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED,

— *v* —

"DE MARE" COMPANY.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED.

— *v.* —

"SUNLIGHT" COMPANY.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, HEREBY GIVE NOTICE, as follows:—

VALIDITY. The Company's Patent has been declared **VALID ON ALL POINTS** after a Fifteen-Day Trial.

NATURE OF INVENTION. The Invention was described by Mr. Justice Wills as a **"PIONEER INVENTION."**

SCOPE OF PATENT. The Patent **HAS BEEN GIVEN A WIDE CONSTRUCTION**; and it was held that the protection given by it was not confined to Mantles manufactured according to the particular prescriptions set out in the Specification.

SHAPE OF MANTLE. The Judge held that a Mantle, even if made in a different form or shape (such as the "De Mare" Fringe or Plume), **IS STILL AN INFRINGEMENT** of the "Welsbach" Patent.

"DE MARE" JUDGMENT. Judgment for an **INJUNCTION, WITH FULL COSTS**, has been given against the "De Mare" Incandescent Gas-Light System.

"SUNLIGHT" JUDGMENT. Judgment was given **AGAINST** the "Sunlight" Incandescent Gas-Lamp Company, Limited, on the question of the **VALIDITY OF THE PLAINTIFFS' PATENT.**

"SUNLIGHT" MANTLES. Last about **100** hours.

"WELSBACH" MANTLES. Last about **1000** hours.

"Sunlight" Mantles **BURN DOUBLE THE GAS** to produce the same candle power as the Incandescent Gas-Light Company's Mantles.

Users of "Sunlight" Mantles are applying to the Incandescent Gas-Light Company to **REPLACE THEM BY THEIR OWN MANTLES.**

WARNING. Users of the Incandescent Gas-Light Company's Mantles upon "Sunlight" Burners **ARE INFRINGERS OF THE COMPANY'S PATENT, AND WILL BE AT ONCE PROCEEDED AGAINST.**

COSTS. Certificates of the Validity of the Company's Patent have been granted both by Mr. Justice Romer and Mr. Justice Wills entitling the Company to Solicitor and Client Costs, which will, **IN ALL CASES, BE RIGOROUSLY ENFORCED.**

INFRINGERS. The Incandescent Gas-Light Company **WILL TAKE PROCEEDINGS AGAINST ALL PERSONS INFRINGING THEIR PATENT, WHETHER**

MAKERS,
WHOLESALE DEALERS,
RETAILERS,
or
USERS.

Users of the Company's Mantles upon Burners not sold by the Company **ARE INFRINGERS.**

"LIMITED LICENSE" WARNING. Judgments have already been obtained against such users from Mr. Justice Chitty, Mr. Justice Stirling, Mr. Justice Kekewich, and Mr. Justice North.

FAITHFULL & OWEN,
11, Victoria Street,
Westminster.

Solicitors to the Incandescent Gas-Light Company, Limited.

April, 1896.

NOTICE.

The attention of the **METEOR INCANDESCENT LIGHTING COMPANY, LIMITED**, having been again called to the Advertisements inserted in various papers by the Incandescent Gas-Light Company, Limited, of Palmer Street, Westminster, to the effect that the "Meteor" Incandescent Gas-Lights are an Infringement of their Patents, and that they will bring Actions for Infringement against all persons found dealing in any manner with such Lights, the **METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, HEREBY GIVE NOTICE** that they are advised that the "Meteor" Incandescent Lights in no way infringe any of the Patents of the Incandescent Gas-Light Company, Limited, that an action has been commenced to restrain such threats, and that they are **PREPARED TO FULLY INDEMNIFY ALL PURCHASERS, DEALERS, AGENTS, and USERS** of their Lights against any Legal Proceedings on the part of the Incandescent Gas-Light Company, Limited.

WILSON, BRISTOWS, & CARPMAEL.

1, Copthall Buildings, London, E.C.,

Solicitors to the Meteor Incandescent Lighting Company, Limited, of 35, New Broad Street, London, E.C.

Nov. 30, 1895.

Fcap. 4to, Cloth, price 7s. 6d., post free.

Practical Photometry.

By William Joseph Dibdin, F.I.C., F.C.S.

LONDON: Walter King, 11, Bolt Court, Fleet St., E.C.

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
Shipments Promptly and Carefully Executed.
London Office: R. Cull, 31, Old Broad St., E.C.

HEBBURN MAIN GAS COALS.
Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.
For Prices, f.o.b. Ship or Delivered by Rail, apply to
THE WALLSEND & HEBBURN COAL COMPANY, LTD.
8 Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

THOMAS TURTON AND SONS, Limited,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
London Office:
90, CANNON STREET, E.C.

LITTLE & GRAHAM, Ld.

THE
INCLINED RETORT
SPECIALISTS

TRANSPORT APPLIANCE WORKS,
SMETHWICK,
BIRMINGHAM.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for
CANNEL & COAL.

TYNE BOGHEAD CANNEL.
Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 38·22 candles.
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.
Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 17·8 candles.
Coke . . . . . 70 per cent.

SOUTH PELAW MAIN GAS COAL.
Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 73·1 per cent.

For Prices and complete Analysis, apply to
THOS. W. DANCE & SONS,
Coal Owners, Newcastle-on-Tyne;
or
E. FOSTER & CO.,
12, John Street, Adelphi, London, W.C.

NEW INCANDESCENT

(SUNLIGHT PATENT)

GAS LIGHTING COMPANY, Ltd.

The Directors beg to announce that the Equipment of their FACTORY at 33 and 34, SHOE LANE, HOLBORN CIRCUS, is progressing rapidly; and in the course of a week or ten days, they will be in a position to make prompt delivery of orders in hand, which will be executed as nearly as possible in precedence of dates of booking.

They likewise take this opportunity to refer to the *withdrawal* by the Incandescent Gas Company of their Appeal against Mr. Justice Wills' recent Judgment in favour of the Sunlight Company. The Action is thereby terminated entirely; and this Company's customers are finally guaranteed by the decisions of the Court against interference of any kind by the Welsbach Company. Any case of such interference or threat of interference, if reported to us, will be immediately summarily dealt with.

COKE-BREAKERS,

PRICES REDUCED.

(THOMAS & SOMERVILLE'S PATENT)

New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,

165, QUEEN VICTORIA STREET, E.C.

And at STROUD, GLOUCESTERSHIRE.

JAMES OAKES & Co.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

HUNTER'S

OXIDE OF IRON.

JAMES HUNTER, MINER, AND SHIPPER OF NATURAL IRISH BOG ORE.

This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.

Samples and Prices on application.

5, PRINCES STREET, PORT GLASGOW.

Telegrams: "HUNTER, PORT GLASGOW."

Established 1872.

LOW MOOR BLACK BED

GAS COAL.

YIELD OF GAS PER TON - 10,375 CUBIC FEET.
ILLUMINATING POWER - 17·50 SPERM CANDLES.
COKE - - - - - - - - 75 PER CENT.

Prices, f.o.r. or f.o.b., on application to

GEORGE & JOHN HAIGH,

RAVENS LODGE AND CONYERS' COLLIERIES,

DEWSBURY.

A TRIAL IS RESPECTFULLY SOLICITED.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

S. J. DITCHFIELD,

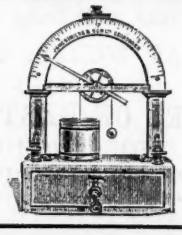
SEAHAM HARBOUR, COUNTY OF DURHAM.

JAMES MILNE & SON, LTD.,

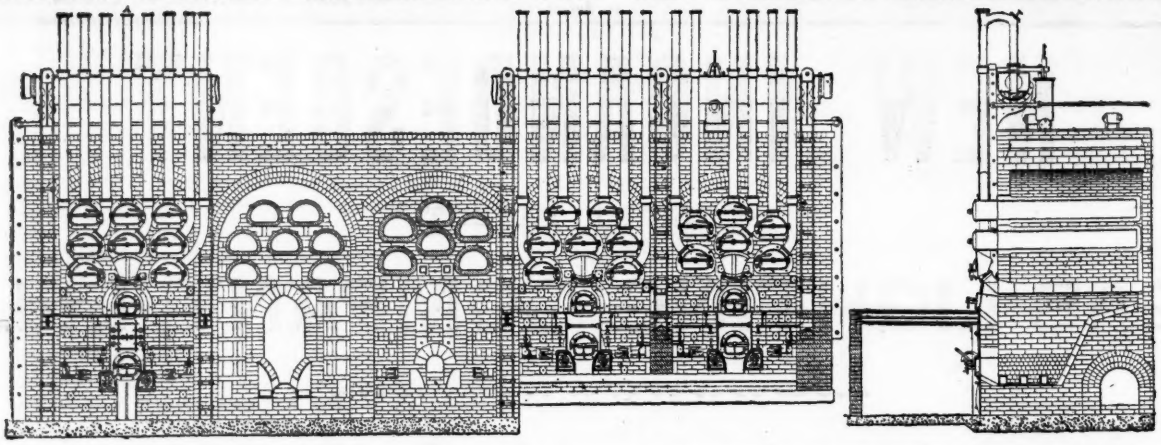
GAS ENGINEERS,

MILTON HOUSE WORKS, EDINBURGH.

LONDON. — GLASGOW. — LEEDS.



HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Full Particulars may be had on application to the Patentee's Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, 5, Stuart Street, Shawlands, Glasgow, Agent for Scotland and Ireland; and to the Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non.*

TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

The Patentee's SELF-SEALING CAPS FOR THE TOP OF ASCENSION-PIPES, and his "SPECIAL" FLUE PORT BOXES, are most important additions to his Carbonizing Plant.

SPENT LIMES NO LONGER WASTE PRODUCTS.

Under C. R. HISLOP'S Patents, all Spent Limes are effectively recovered at from one-third to one-half the cost of New Lime.
Further Information and Pamphlets from Principal Agent.

INCANDESCENT STREET, &c., GAS LIGHTING.

The most successful adaptation of this System to Street Lighting extant.

APPLICABLE TO EXISTING LAMPS.

THOROUGHLY TESTED.

Great Reduction in Mantles, Chimneys, Attendance, &c.

It not unfrequently happens that much damage is done to mantles whilst the attendant is cleaning the inside of the lamp by reason of there being far too little room therein; and this defect for the purpose of avoiding such damage when the burners and mantles cannot be removed leads to great neglect in cleaning, and consequent loss of light by dirty disagreeable lamps.

The same facility applies to other lamps of 2 or 3 light clusters.

Do not condemn your Incandescent Lights without a fair trial.

ECONOMICAL, EFFICIENT, SATISFACTORY.

Successful Results guaranteed in all Situations.

For further Particulars, apply to

THE

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[See Illustrated Advertisement, June 2, p. 1243.]

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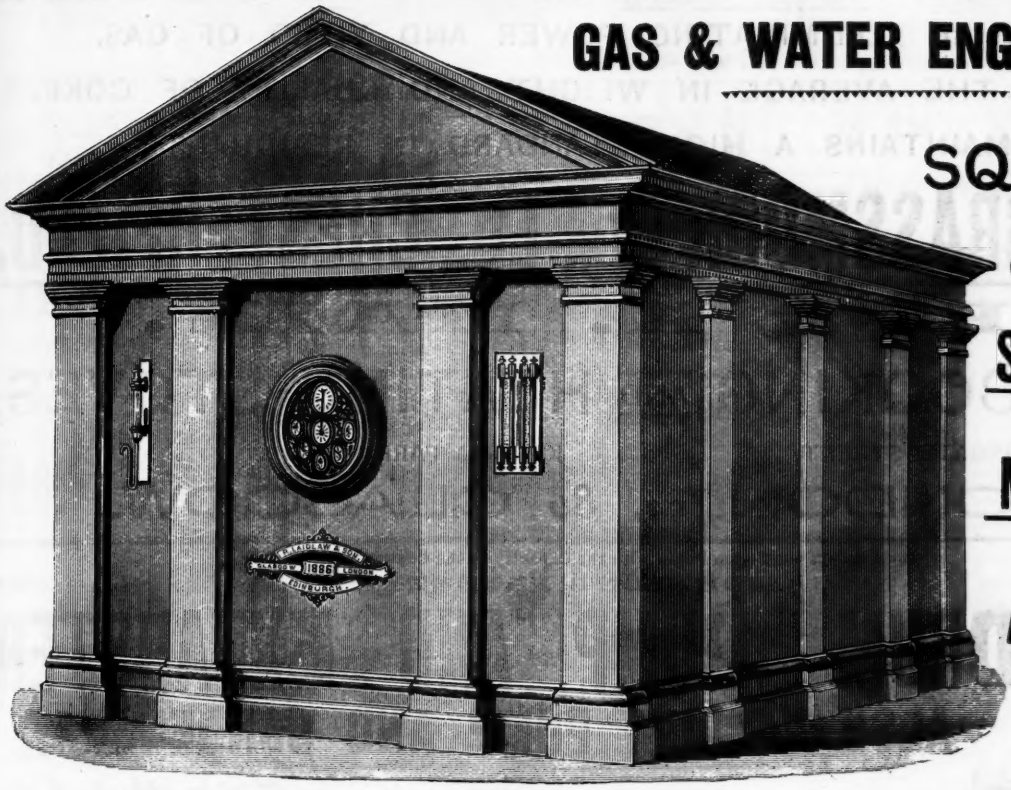

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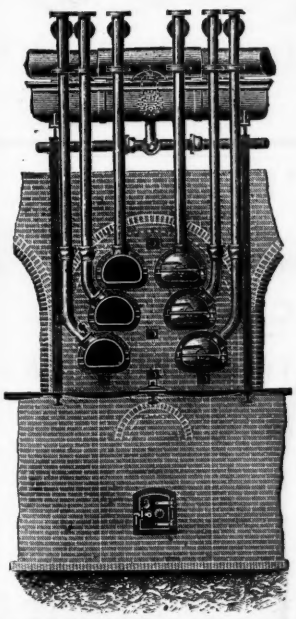

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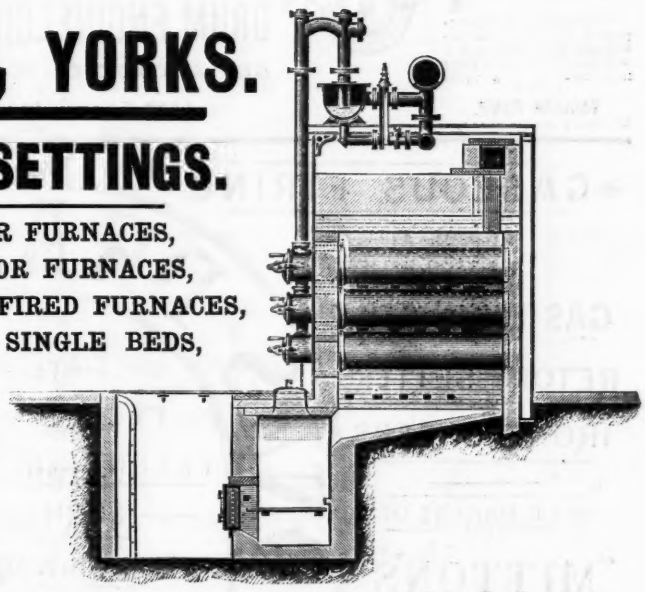

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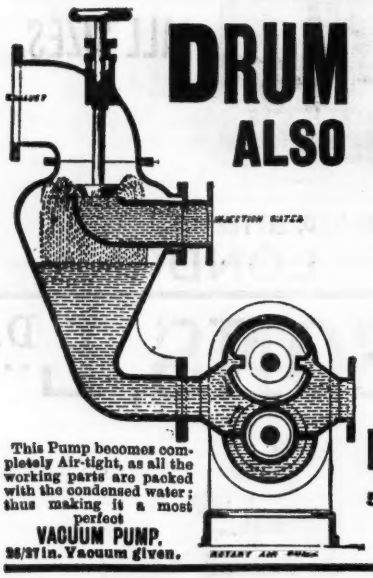

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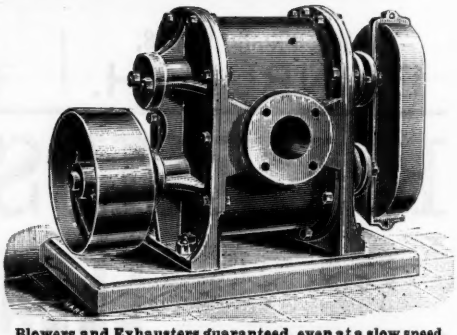

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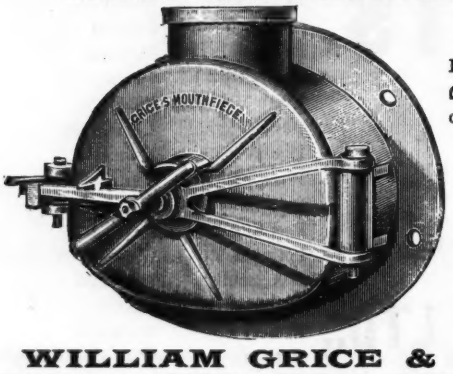

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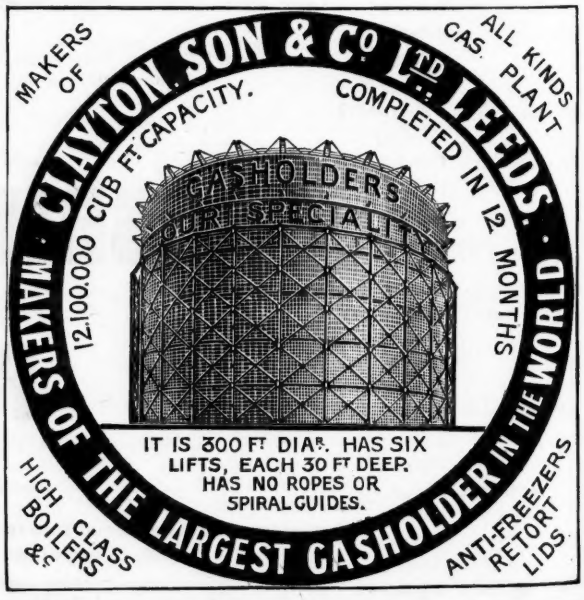
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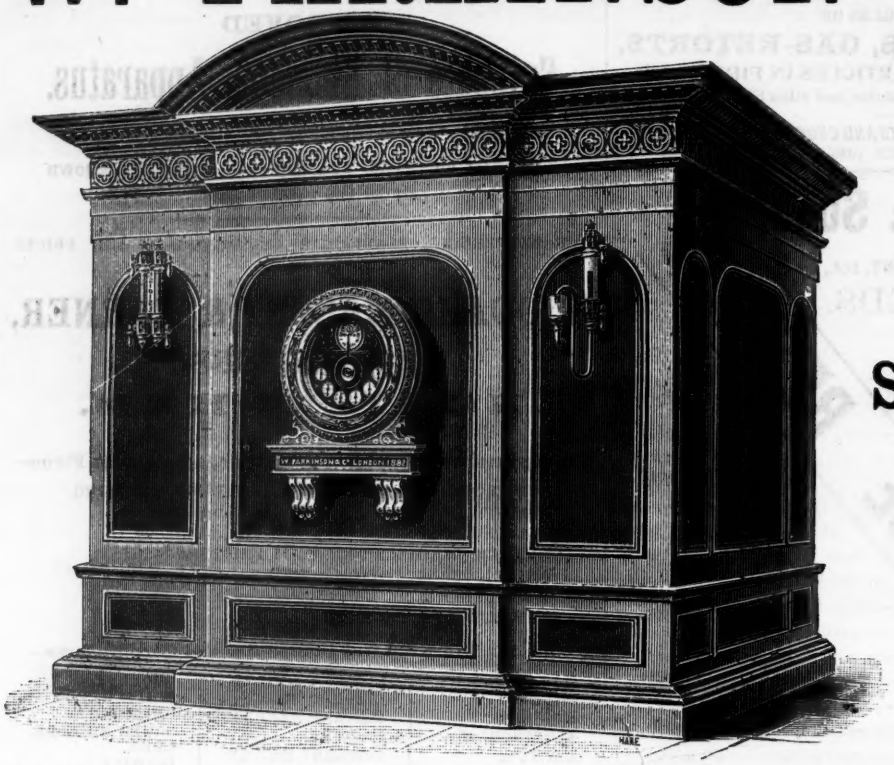

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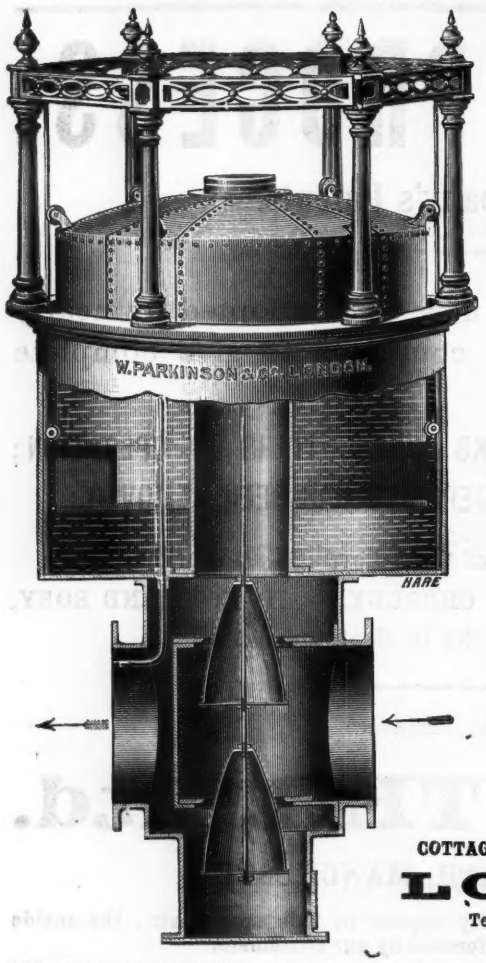

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[See also Advt. p. 1306.

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